ENGINEERING NEWS.

Tribune Building, New York City.

GEO. H. FROST, PROPRIETOR.

SATURDAY, APRIL 30, 1881.

OUR readers will please to bear in mind our list of Weale's series of scientific books as published in our advertising columns. We have already sold a large number, and the demand increases daily. We are very much pleased with the growth of our book trade this year; we have done our best to fill promptly all orders sent to us, and we feel that our diligence has been appreciated.

RUSSELL'S Common Sense Binder is used by the New York *Sun*, *Tribune*, *Mail*, *Truth*, *Times*, *World*, *Express*, *Puck*, the *Nation*, Philadelphia *Times*, *Congressional Record*, the *Christian Union*, the *Mining Record*, *Mackey's A B C Guide*, International News Co., etc., etc., etc. Also by ENGINEERING NEWS and all the other best class journals in this city. The price is $1.50, sent post-paid.

THE American Society of Civil Engineers will hold its annual convention for 1881 in Montreal, Canada, commencing June 15. The programme is not yet arranged, and, while we have no official authority for the statement, yet we believe that the rendezvous will be Niagara Falls, whence the party will proceed to Montreal by steamer, thus "doing" the Thousand Islands and Rapids of the St. Lawrence previous to the meeting in Montreal. We will give particulars as soon as we get them.

WE this week commence the publication of an article on the New York and Brooklyn Bridge, compiled from the official reports and from observation. Considering the magnitude of the work, the almost infinite variety of necessary detail, and the long time of building, it will only be possible for us to note and briefly describe the most important features. We hope that after the bridge shall have been completed some one of the eminent engineers engaged upon it will take upon himself the duties of chronicler and give its history in all the critical exactness which its immensity requires.

THE DEMAND FOR ENGINEERS.

The enormous amount of railway and other engineering work now projected and in progress in this country has created a demand for civil engineers such as the profession has not experienced for many years. It is now difficult to procure as many competent men as are wanted. Prof. Chas. E. Greene, of Michigan University, writes us: "Engineering is a first-rate profession now, quite a contrast to a few years ago. I have more applications for young men than I can supply from our graduates. Most of our young engineers are doing very well indeed."

Mr. Chas. E. Billin, General Manager of the Illiana Coal Co., Indianapolis, has been in our office twice within a month inquiring for competent engineers and surveyors to make some topographical surveys in Virginia, and some railway surveys in Indiana; the Consulting Engineer of the Okeechobee Lake survey in Florida wrote us for an assistant some weeks ago, and from several other quarters we have received similar applications. At the same time we have frequent applications for situations from foreigners and also from young men just starting out in the profession. We can do very little for these applicants. Whatever information we get we publish as soon as possible, and we can do nothing better than recommend a careful examination of this and the railway journals so as to find out where works are in progress, and then go there. If engineers cannot secure business *now* they never will, and we can do very little personally to assist them except by the method above suggested. We believe that in Mexico there are splendid possibilities for active, intelligent, energetic men who will go there *to stay*, to develop the country and take advantage of the great demand that must soon set in for just such services as they have to offer. The investment of American capital there already is enormous, and the railways projected do not yet amount to what the single State of Indiana possesses. The country is barren of almost everything in the way of intelligent and capable men, while its productive resources are enormous. This "railway age" that has set in on Mexico will last, and there is room for thousands of our capable men to develop there if they choose to go. The days of revolutions and brigandage in Mexico are numbered, and the talk of annexation or forcible capture by Americans is utter nonsense. The "live Yankees" from Boston and vicinity that are running things so lively there now are after money, and they will not tolerate jeopardizing their investments by either Mexican or American politicians.

The "good times" for civil engineers have come, and they who do not choose to take advantage of this "tide in their affairs" must not sit down and grumble when they are left behind in the race for fortune.

THE NEW YORK AND BROOKLYN BRIDGE

On the 16th of April, 1867, the Legislature of New York passed an act "To incorporate the New York Bridge Company, for the purpose of constructing and maintaining a bridge over the East River, between the cities of New York and Brooklyn," and named among the incorporators, and constituted them a Board of Directors, the following named gentlemen: John T. Hoffman, S. B. Chittenden, Edward Ruggles, Smith Ely, Jr., Samuel Booth, G. T. Jencks, Alexander McCue, H. E. Pierrepont, Martin Kalbfleisch, John Roach, C. A. Townsend, H. G. Stebbins, C. E. Bill, C. L. Mitchell, T. B. Myers, S. L. Husted, W. A. Fowler, W. W. W. Wood, A. H. Green, E. W. Corlies, W. C. Rushmore, E. S. Mills, A. W. Craven, A. W. Benson, T. B. Cornell, J. N. Hayward, J. Van Anden, P. P. Dickinson, A. M. Wood, J. C. Brevoort, W. Marshall, S. McLean, J. W. Combs, W. Hunter, Jr., J. H. Prentice, E. Driggs, J. P. Atkinson and John Morton. The capital stock of the company was fixed at five millions of dollars.

The act provided for the obtaining of all requisite lands, the borrowing of money, the opening of approaches, etc. One clause stated that the cities of New York and Brooklyn, or either of them, could at any time take the entire bridge property upon paying to the corporation the cost thereof plus thirty-three and one-third per cent. The bridge must not obstruct the navigation of the East River, and must not be at an elevation of less than 130 feet above high tide at the middle of the river.

The Brooklyn terminus was fixed at a point at or near the junction of Main and Fulton streets; the New York terminus could be at or below Chatham square, but could not be south of the junction of Chatham and Nassau streets.

An act passed June 5, 1874, states that after certain conditions shall have been fulfilled the Board of Directors shall consist of twenty members; the Mayor and Comptroller of New York shall appoint eight, and the Mayor and Comptroller of Brooklyn shall appoint eight, the officials being *ex officio* members. The present Board is so constituted, its title being "The Trustees of the New York and Brooklyn Bridge." After the dissolution of the company, as provided for in this act, the bridge shall be a public work, to be constructed by the two cities, two-thirds of the expense being incurred by Brooklyn and one-third by New York.

An act in relation to the bridge which passed Congress and was approved March 3, 1869, states that the bridge when completed shall be a lawful structure and post road for the conveyance of United States mails, provided that it shall not obstruct nor impair navigation, and provided the plans be approved by the Secretary of War before the commencement of operations.

Under date of June 21, 1869, the Chief of Engineers, by direction of the Secretary of War, wrote to the president of the company that the centre span of the bridge shall under no conditions of temperature or load be less than 135 ft. above mean high water; that no portion of the grillage, nor enrockment of the pier or tower foundations above the natural river bed, shall project beyond the pier lines; and that no guys nor stays shall ever be attached to the main span, which shall hang below the bottom cords of the bridge.

Mr. John A. Roebling, in his first report after having accepted the position of Chief Engineer, made in 1867, stated that the first consideration in regard to the location, was the engineering question to decide the practicability of the work: and the second was the cost, to ascertain if the undertaking would pay as an investment. The Brooklyn terminus having been fixed by charter, Mr. Roebling confined his attention to the New York one, and considered the comparative merits of two stations —one at Chatham Square and the other at the junction of Chatham and Nassau streets. The preliminary surveys were confined to these two routes, as no ground was available between them for want of sufficient elevation; but for the sake of comparison another line was laid down, terminating at the intersection of the Bowery and Canal street. These three routes are considered in the following table of distances:

	Routes.		
	Park Line.	Chatham Street.	Bowery and Canal.
Distance across river from pier line to pier line	Feet. 1,512	Feet. 1,362	Feet. 1,345
River span from center to center of towers	1,600	1,480	1,433
Length of New York approach from terminus to center of tower	2,381	1,916	2,771
Length of Brooklyn approach.	1,881	1,804	1,780
Total length	5,862	5,200	5,984
Elevation of New York terminus above high tide	36	32	49
Elevation of Brooklyn terminus above high tide	68	68	68

This table shows that the Chatham Square line was 662 feet less than that from the Park, and 784 feet less than that from the Bowery and Canal street. After carefully considering the value of the property to be condemned on the two main routes, the grades—that of the New York approach on the Park line being 3.44 feet rise in 100, and that on the Chatham Square being 4.33 feet—the slight difference in the cost—the Chatham Square being about one-half million of dollars less—and the fact that the City Hall Park would be the great focus of travel in the future, Mr. Roebling decided that the Park line would most favor the interests of the public as well as the bridge company, and consequently confined all his detail labors to that route. In regard to the practicability of the work he thought that the spans on both lines were feasible, and that any span of less than 3,000 feet was practicable, and with the best quality of steel wire even greater spans might be made secure for all kinds of traffic.

In regard to the strength of suspended iron and steel, Mr. Roebling said:

"A bar of good wrought-iron one inch square section will support 60,000 lbs. before it breaks.

This bar weighs 3.36 lbs. per foot lineal, and will, therefore, support 17,858 feet of its own length. That is, if a bar of this length is suspended freely to a fixed point, its upper end will be exposed to a breaking strain. Here, therefore, is the limit of the strength of good wrought-iron. When the same bar is drawn down into No. 9 or No. 8 wire, with proper care, its strength will thereby have been increased from 60,000 lbs. to 100,000 lbs., and over, per square inch solid section. No. 9 iron wire can be manufactured which will weigh 1 lb. per 18 feet of length, and will bear 1,800 lbs. Sixty and one-half of these wires will have an aggregate metal section of 1 square inch, consequently its strength is equivalent to 108,900 lbs. per square inch. By multiplying 1.800 by 18 we have 32.400 feet of lineal wire, which, if freely suspended, will support itself. This length, however, produces a breaking strain, and rupture may take place any moment. Cutting off two-thirds of this length, and leaving only 10,800 feet suspended, it will, if left undisturbed and kept from oxidation, support its own weight any length of time. Now suppose this wire, in place of being suspended vertically, was suspended horizontally across a wide chasm with a deflection of one-seventh of the span, then the tension resulting would be the same. But as we begin to reduce the deflection and draw the wire tighter, we increase its tension. With a deflection of one-tenth of the span, the tension of the wire, resulting from its own weight, will have been increased more than one-third.

The cables of the East River bridge will have a deflection of 128 feet which is 0.08 of the span, and the tension which is produced thereby will be about 1½ of the weight of the wire. In order now to ascertain the length of span which may safely be attempted with a deflection of 0.08 we have to reduce the above 10,800 feet to 6,480 feet. In other words, the best quality of iron wire, if suspended over a chasm of about 6,000 feet, and with a deflection of 0.08 or 480 feet, will only be exposed to one-third of its breaking strain.

It is plain now that as this span is reduced with the same ratio of deflection the wire will gain in strength, and will be able to support safely an additional weight besides its own. Reducing the width of the chasm to 3,000 ft., the tension will only be ½ of the breaking strain, and as the width is being still further shortened, so will the tension of the wire be lessened, and consequently, in the same proportion may we increase the extra load it will safely bear. If we substitute steel wire in place of iron wire, we will still further increase its strength according to quality. And as the rate of strength is increased, in the same proportion may the span also be increased.

From the above simple facts and considerations, it is plain that the central span of the East River Bridge, which is only 1,600 ft. from center to center of tower, is far within the safe limits of good wire. A span of 1,600 ft. or more can be made just as safe and as strong in proportion as a span of 100 ft. The larger span is not a question of practicability, but simply a question of cost. But as the span increases, so does also its cost increase."

SURVEYS.

No actual line had ever been located upon the Park route, the proposed line having been traced upon the most accurate maps obtainable. Several center lines were run on trial, and the one finally agreed upon narrowly escapes the Fulton Ferry slip on the Brooklyn side and the Williamsburg ferry on the New York shore. In locating most bridges, great attention is paid to the difficulties likely to be encountered in getting foundations for piers, in making approaches, and similar matters, but in this case such considerations were ignored, and the towers and anchorages were placed where the exigencies of the case brought them.

A detailed survey of all the property on the line of the bridge was made, and the location of the Brooklyn tower selected during the summer months of 1869.

It was while engaged in locating the position of the Brooklyn tower that Mr. John A. Roebling, Chief Engineer, met with a lamentable accident—the crushing of his right foot by the shock of a ferry-boat against the fender rack of spring piles on which he was standing. Lockjaw set in, and after sixteen days of extreme suffering terminated in death.

In August of the same year his son, Col. W. A. Roebling, was appointed Chief Engineer of the work.

THE BROOKLYN FOUNDATION.

One trial boring, made in 1867, showed gneiss rock at a depth of 96 ft. below high water. The strata penetrated consisted, besides the surface filling, principally of hard pan and alternate layers of trap boulders imbedded in sand and clay. Below a depth of from 50 to 60 ft. the material was so compact that the bore hole stood without tubing for weeks. No necessity existed, therefore, for going down to rock, since at a depth of from 45 to 50 ft. a bottom was reached which was entirely satisfactory as a foundation.

As the great desideratum was to obtain a foundation of uniform character over the entire space, whatever the depth might be, it was decided that a solid timber foundation of sufficient thickness to act as a beam, and having the mass requisite to insure an even settling, would meet the requirements of the case. The magnitude of this feature became evident when it was considered that it must support a weight of seventy thousand tons, with a height of three hundred feet above the foundation, upon which the permanent pressure would be five tons per square foot.

It was well known that timber immersed in salt water was imperishable, and if sunk beneath the river bed would be safe from the ravages of seaworms. Consequently it at once suggested itself to make this timber platform as much as possible a part of the caisson.

(TO BE CONTINUED.)

THE WATER SUPPLY PROBLEM.

The Brooklyn *Daily Times* published in a recent issue a lengthy and exhaustive article upon the water supply question, consisting mainly of extended interviews with the superintendents or chief engineers of water departments in the principal cities of the Eastern States, and in other localities. We print in another portion of ENGINEERING NEWS a number of extracts from it. The article complete will amply repay perusal It has been published in pamphlet form and can be had upon application at this office.

While conveying to the well-informed reader upon the subject no additional information—if we except some late statistics and tables—confirmatory of impressions already formed, it has a value in emphasizing in a direct and definite manner the opinions of those who are best competent to judge of what must be the ultimate solution of the water supply problem. Municipalities in our day and generation have been recklessly improvident of the people's money in providing costly aqueducts and reservoirs, some of which rival in extent and value the magnificent edifices of a similar kind which Imperial Rome constructed when she was the mistress of nations; but the result has invariably been that they have, in a comparatively brief time, failed to fulfill the purposes for which they were intended. The natural extravagance and wastefulness of the people has grown with the abundance supplied them. How to correct this evil and, at the same time, lessen the expense of conducting water departments, is conclusively shown by some of the best authorities that it would be possible to find. The meter system alone, applied in every place where the consumption of water is great, is the only remedy. It seems a pity that the public at large do not look at this question with the intelligence it demands, and that those who, presumably, form public opinion—the daily press—have shown no desire or inclination to properly understand it. The water meter, like other similar innovations, is looked upon with distrust. It is a fact that the newspapers of some of our large cities treat water boards who advocate the introduction of the meter system as conspirators against the safety of the public weal and the public treasury. There are some people, fairly intelligent upon other subjects, who regard the water meter with some such feeling as they would entertain for an infernal machine, and who never mention it except to characterize it in terms that would lead one to believe they looked at it as a sort of metallic contrivance, full of awe and mystery, and used by designing men to deprive them of their rights and privileges. How erroneous and foolish all this is can be proven by the most positive evidence. The meter, in fact, is a silent but vigilant protection of the pocket of the careful householder, and an accurate detective and register of the extravagant one, while to the commonwealth at large it is the best correction of that greatest extravagance of modern civilization, the almost criminal waste of water. Like every other new improvement, however, it must, we suppose, have its period of perplexities. The steam engine, the electric telegraph, the sewing machine, was each, in its turn, the object of doubt, distrust and neglect, but time eventually proved their great benefit and utility, and without them the gigantic strides made by the world under their auspices would never have been accomplished. So it is with the water meter. Those who know what the want of it produces have but one opinion to express, and it is that, sooner or later, it must be adopted in every city throughout the world. And it is proper that it should be so. The designers of water-works never contemplated that an article which the continual increase of population is making scarcer every year should be wasted recklessly. It has fairly become a merchantable commodity, and should be treated in the same spirit that other merchantable commodities are. The maximum quantity required per capita has been ascertained, and allowing even for a mild extravagance in its use, the water department of no city in the country would ever be confronted with a water famine if its inhabitants could be kept to this liberal allowance. But what do we see? Cities with from 100,000 to over 1,000,000 of inhabitants using a daily allowance per capita of from seventy to one hundred and twenty gallons of water, while in others, where the meter system is in general use, this quantity is brought down to about one-third of these figures.

We have not the space to enter into as detailed a review of the article referred to as it merits. It presents the question with great unanimity and force: it is entitled to careful attention and consideration; reflects credit upon the journal in which it has appeared for the enterprise displayed in procuring it; and it is a valuable contribution to the literature of a subject which should be familiar to every citizen and taxpayer in the land.

PERSONAL.

Col. George E. Waring, Jr., Sanitary Engineer, of Newport, sailed for Europe on the 22d.

Robert H. Sayre, Superintendent and Chief Engineer of the Lehigh Valley Railroad, has gone on a trip to California.

Gen. Wm. Sooy Smith, chief engineer of the Glasgow steel bridge, and Mrs. Smith, arrived in New York by the Cunard steamer Gallia, on the 25th.

The offices of the Rand Drill Company, whose advertisement appears elsewhere in this journal, have been removed to 240 Broadway, opposite City Hall Park.

Mr. Alfred P. Boller has been appointed Chief Engineer of the Manhattan Elevated Railway in place of William F. Shunk, resigned. Mr. Boller

is an engineer of wide experience, especially in bridge construction.

Mr. Chas. E. Billin, former secretary of the Engineers' Club of Philadelphia, is General Manager of the Illiana Coal Co., an organization formed for working the bituminous coal lands on the line of the Indianapolis, Decatur & Springfield Railway.

SAN FRANCISCO, April 25.—J. L. Clements, for many years past chief engineer of the Southern Pacific Railway, leaves the service of that company to take charge of the engineering department of the Atlantic & Pacific Railroad Company. Five other engineers go with him.

Prof. Mansfield Merriman, of the Lehigh University, Bethlehem, Pa., and a party of his class in engineering have been spending a week in the vicinity of Hazleton, Pa., where they were engaged in making some surveys in the mines of Messrs. A. Pardee & Co., as a practical part of their studies.

Omar N. Gardner has been re-elected City Civil Engineer of Akron, O. The City Council of this city has taken steps toward the creation of a Board of Public Works. The city is just on the eve of making great public improvements which, in addition to what has already been done, need the care and supervision of such a body.

CHICAGO, April 27.—Fred Grant (late Lieut. Col. U. S. A.) will leave Chicago to-morrow with his family for New York. He will in future have an office in that city, but will spend much of his time in Texas as President of the Texas Western Narrow-Gauge Railway, a road projected from Houston to Presidio and El Paso Del Norte. It is to be 660 miles long, but only 42 miles, from Houston to Presidio, have been completed and in operation. Capital has been subscribed for the immediate extension of the road to Presido and El Paso Del Norte, and President Grant expects to build 200 miles of the line before the end of the present year.

E. P. North, Member A. S. C. E., has been appointed Chief Engineer and Superintendent of the Sinaloa and Durango, R. R., Mexico. This road extends from Altata on the Gulf of California, 120 miles north of Mazatlan, to Durango, a distance of about 220 miles. It is one of the Mexican Central roads. It is proposed to begin at once the construction of forty miles of the new line from the port of Altata to Culiacan, the capital of the State of Sinaloa. Surveying parties will leave New York in a few days for the purpose of running the line from Culiacan to the plateau of Durango. The address of Chief Engineer North, in New York City, is 104 East 20th street.

Among the arrivals by the Gallia on the 25th were the Duke of Sutherland, his son, the Marquis of Stafford; Mr. George P. Neale, Mr. J. P. Bickersteth, Mr. George Crosfield, Mr. Henry Crosfield, Mr. O. L. Stephens and Mr. H. A. Knowles, M. P., all directors of the London & Northwestern Railroad, and Mr. Henry Wright, the private secretary of the Duke. With the party also was Dr. W. H. Russell, the former well-known correspondent of the London *Times*. These distinguished gentlemen are on a visit partly of pleasure, but mainly with a view to survey for themselves the railway system and improvements of this country. They will go first to Philadelphia, and from there to Baltimore and Washington, and returning visit Boston, and go thence to Quebec and Montreal. Then West, making quite an extended stay at Altoona, in Pennsylvania, and will visit St. Paul and Chicago, and at St. Louis the party will separate, all but three coming back by way of Pittsburgh. The others will go on westward as far as San Francisco.

James Tillinghast, who is appointed Assistant President of the New York Central, began railroading in 1850 as a fireman on the New York Central. In 1852 he went to the Rome & Watertown road as its Master Mechanic, and in 1856 he became connected with the Collingwood railroad in Canada, holding the position of Master Mechanic and Assistant Superintendent. In 1863 he was a proprietor of a line of steamers plying between Sarnia and Chicago in connection with the Grand Trunk Railway. One year later he became Naster Mechanic of the Michigan Southern Railroad, and in 1865 was appointed Assistant Superintendent of the Buffalo and Erie railroad. Before the year expired, Mr. Tillinghast was offered the position of Division Superintendent of the Central by the late Dean Richmond, which he accepted. In 1869, President Vanderbilt made him General Superintendent of the New York Central, with full charge of the lines west of Troy and Albany. For a short time he was President of the Canada Southern Railway, but had to relinquish the position on account of the pressure of other duties. Mr. Tillinghast is a man of rare executive ability, thoroughly posted in everything that pertains to a railroad, and polite and sociable in his intercourse with his associates. Much of the success of the Central Railroad is due to him. His office will hereafter be at the Grand Central Depot in New York, but he will retain his residence in Buffalo. Mr. Tillinghast is about sixty years of age.

The officers of the Mexican National Construction company, which is building the Mexican National Railway (known generally as the Palmer-Sullivan concession) are: President, Walter Hinchman; Treasurer, Wm. M. Spackman; Assis-Treasurer, John Dougherty; Secretary, W. W. Nevin; General Manager, G. Clinton Gardner; Purchasing Agent, A. R. Roberts. Offices at No. 17 Cortlandt street, New York.

Mr. G. Clinton Gardner, late of the Hoosac Tunnel Railway, is also General Manager of the Mexican National Railroad, which the construction company is building, and has issued the following order:

"Chief Engineer W. C. Wetherill will take personal charge of all surveys and construction work south of and including Zacatecas and San Luis Potosi, reporting direct to this office, and will at all times keep General Agent James Sullivan, at Mexico, fully advised of the progress of the work. The Southern General Division will be sub-divided into five divisions:

"The Toluca Division, from Mexico to Toluca; the Acambaro Division, from Toluca to Acambaro, Salamanca and Celaya; the Zacatecas Division, from Celaya and Salamanca north; the Morelia Division, from Acambaro to Patzcuaro, or beyond and westward; the Colima Division, from Manzanillo to Colima, and north and eastward.

"Principal Assistant Engineer E. Miller will take personal charge of all surveys and construction work north of San Luis Potosi, reporting direct to this office, and will at all times keep Manager A. C. Hunt, at Laredo, fully advised of the progress of the work."

Mr. G. Clinton Gardner is General Manager of the Texas-Mexican road, which is the Texas Division of the Mexican National, and includes the Corpus Christi, San Diego & Rio Grande.

ONE of the pleasant features of our business is our growing book trade. Our customers hail from the remotest corners of the continent, and it is a very rare occasion that complaint is found as to our promptness in filling orders. Hundreds of our subscribers are remote from book-stores, and to us they look for their supplies of reading matter, from the latest novel to the most popular "Field-book for Engineers," and we always guarantee safe delivery. We do not know of a single instance where there has been an occasion of permanent dissatisfaction in a customer who has ordered from us. We hope to see this trade largely increase henceforth, and we will guarantee the most liberal terms, prompt dispatch, and, if possible, entire satisfaction to every patron.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 164.)

XII.—BUFFALO.

Buffalo, New York, in lat. 42° 53′ N., long. 78° 55′ W., is at the foot of Lake Erie and at the head of the Niagara River. The city extends down the Niagara River five miles, and about the same distance back from the river, the northerly and easterly portions being but thinly settled.

Founded in 1801, and burned by the British on December 31, 1813, its population in 1852 was about 50,000, when a private company began supplying the city with water pumped from the river by two Cornish Bull engines, with steam cylinders of 50-in. diameter and 120-in. stroke, the pumps being 24-in. diameter. A force main from each pump led to a stand-pipe 36-in. diameter, from which a single main of 20-in. diameter conveyed the water 1,800 ft. to a reservoir 533 by 201 ft. at the top of the bank. The water surface was 88 ft. above the pumps and 3 ft. below the bank. The banks are 13 ft. wide at the top with slopes of 1½ to 1, and have stood well. The water is 21 ft. deep.

In 1859 two pumps of 14-in. bore were added to each engine, attached to cross heads on the piston rods.

During the first seven years of their running, the aggregate cost of repairs to these engines was not more than $300.

A condensing beam engine working a double-acting pump of 31½-in. diameter, and of 8 million gallons capacity, was erected about 1865 and is still in use.

The works were purchased by the city in 1868. The two old engines were remodeled and converted into a compound coupled beam engine, which was used until 1874 and then abandoned. In 1872 this engine was reported as not to be depended upon, and a Worthington pump of 10 million gallons capacity was erected.

In 1876 another Worthington pump of 15 million gallons capacity was added, and a third is now in course of erection.

In January, 1871, a rotary Holly pump of 1½ million gallons capacity, taking its supply from the force main about 20 ft. below the reservoir and pumping directly into the mains, was constructed for a high service and fire supply. In 1874, this was found to be inadequate for the demand, and a piston pump of 2½ million gallons capacity was erected. In 1878 another engine, driving a direct-acting piston pump of 6 million gallons capacity, was added to the direct supply system.

The water was at first taken from the river through a tunnel terminating at Bird Island pier.

In 1873 a new tunnel was built from the shore to an inlet pier 700 ft. farther out than the first one. This tunnel was 22½ ft. below the river bottom. The old tunnel was then found to be more than half filled with sediment. It was cleaned out, and the connecting conduit between the shore shaft of the tunnel and the pump well of the engine house lowered 8 ft. to correspond to an inlet to the new tunnel at Bird Island pier. This inlet was placed 8 ft. lower than the old one, because in December, 1872, and January, 1873, the water in the lake had fallen below the inlet, and it was necessary to pump from the lake or river into the tunnel.

*Copyright, 1881.

The new tunnel to the outer inlet was completed in December, 1875.

The distribution pipes are of cast iron, except 3,530 ft. of wrought iron and cement pipe laid in 1853. There are 102.1-miles in use, 19 miles of which are of 4-in., and 26 miles of 6-in. diameter.

Three and three-tenth miles of pipe, which had been laid too near the surface, froze in the winter of 1875 and broke, and had to be replaced. Since this all pipes have been laid 6 ft. below the surface. Meters are not used.

The number of water takers on Dec. 31, 1880, was 9,099.

In 1871–72 a well was drilled at the engine house, 1,275 ft. deep, in the hope of obtaining a supply of natural gas for fuel and lighting, but without success, after an expenditure of $9,406.44.

The cost of the original works of the company, built after the plans of William J. McAlpine, C. E., was $400,000. During the first eight years four dividends were paid. In 1860 the yearly cost of maintenance was about $20,000, and the company paid 6 per cent. dividends with the aid of $20,000 received from the city for water used for public buildings and fire purposes.

In 1867 and 8 the city paid a rental of about $50,000. The works were purchased by the city on Aug. 15, 1868.

The expenditures to December 31, 1880, have been:

For purchase of works	$705,000.00
For extensions	2,345,000.00
For maintenance	773,566.83
Expenditures	$3,823,566.83
Exclusive of interest on the bonds.	
Revenue	2,051,094.63
Outstanding indebtedness	2,950,000.00

The works have been controlled since 1868 by a board of three commissioners. A. R. Ketchum was engineer and superintendent for the company before the sale to the city, and until 1873.

Louis H. Knapp, C. E., was engineer of the enlargements of the works from July 1873, to Aug. 31, 1876, when the office of engineer was abolished. Geo. Hosley has been superintendent since 1873.

The population, pipeage and consumption each tenth year have been as follows:

Year.	Population.	Miles of pipe.	Consumption in millions of gallons per day.
1800	81,830	25	3.50
1870	117,714	56.6	6.(0
1880	155,137	102.1	10.53

XIII.—WASHINGTON.

Washington City, the seat of the United States Government, is in the district of Columbia, in lat. 38° 53′ 20″ N., long. 77° 0′ 27″.9 W., on the north bank of the Potomac River, at the head of tide-water, 184 miles from the ocean. It has a water front of four miles on the Potomac River, and three and a quarter miles on the Eastern Branch. A large portion of the city is flat, and but little above the river level, but the ground rises quite rapidly on each side of the plain, the Capitol being 89.5 ft., and some points in the city 104 ft. above mean tide-level.

The City of Georgetown, which lies west of Washington and is separated from it by Rock Creek, is included in the district supplied with water. Portions of its surface rise to 200 ft. above tide.

Incorporated in 1802 with a population of 4,000, Washington was supplied only by wells until 1859.

The works for supply from the Great Falls of the Potomac River, 17 miles above Washington, were begun in 1853 by the U. S. Government after the plans and under the charge of Captain Montgomery C. Meigs, of the Corps of Engineers, U. S. Army, now Quartermaster-General.

A short distance above Great Falls a dam diverts a portion of the water of the river into the aqueduct. This dam is of cut stone masonry, with a backing of rip rap. It was begun in 1864, after the plans of Silas Seymour, C. E., and was completed in its present state in December, 1867. It extends only across the Maryland Channel of the river to Conris Island, beyond which lies the main channel of the river.

Its top is 148 ft. above tide level at Washington.

A culvert under the Chesapeake & Ohio Canal conducts the water to a gate-house, whence it passes into the aqueduct, which is circular, 9 ft. in diameter, built of brick; is 12 in. in thickness and has a grade of 0.75 ft. per mile.

The location of the line of aqueduct was so made that the greater portion was in cutting. In earth the bottom section was carefully dressed to a semi-circular form and the brick laid in the trench.

On embankments the bank was carefully built to the level of the centre of the conduit, and after setting one season the lower semi-circle was excavated and the brick laid on the earth.

Some cracks appeared before water was let in, but no serious breaks have occurred, though the whole conduit has settled on some embankments for more than a foot, thus destroying the uniformity of the grade.

Two valleys of streams are crossed by masonry bridges. The Griffith Park bridge is an elliptical arch of 75 ft. span and 15 ft rise. Cabin John Bridge is a segmental arch of 220 ft. span and 57 ft. rise. The voussoirs are of dressed Quincy granite, with a super-imposed arch of squared sandstone. The brick conduit is carried over all bridges, the backing being of rubble masonry and the side walls of the bridges of squared sandstone. When the water was first admitted to the conduit, Cabin John Bridge leaked quite badly. The joints and face of the brick masonry in the lower semi-circle of the conduit were cleaned and hacked with hatchets, and plastered with two coats of Rosendale cement mortar, well rubbed on, the second coat being applied before the first was dry, and the two being about ½ in. thick. This stopped the leaks effectually.

At nine miles from Great Falls, the aqueduct discharges into the receiving reservoir formed by damming Powder Mill Branch, a stream which receives the drainage of above 4,000 acres. From this reservoir, which has 50 acres of water surface and a capacity above the bottom of the aqueduct of 176,000,000 gallons, the city was supplied from January, 1859, to December, 1863, at which latter date the Potomac water was introduced.

The expectation that the Potomac water, which is frequently very muddy, would have time to settle in this reservoir before being drawn from its outlet, 3,600 ft. from the inlet, was not realized, in consequence of the turbidity of the water collected from the drainage area of the reservoir itself. In 1864–5, a connecting conduit was built from the inlet to the outlet to enable Potomac water to be carried directly to the city in case of freshets in Powder Mill Branch.

The aqueduct is continued from this reservoir for two miles to the distributing reservoir at Drover's Rest, which is built in excavation and embankment, and is nearly a rectangle, 2,250 by 800 ft., at flow line, which is 135 ft. above tide, and 13 ft. deep, in two divisions.

The inner slopes are lined with dry walls, 12 to 18 in. thick, laid on 6 in. of broken stone. On the north side a conduit, 7 ft. in diameter, connects the influent and effluent gate houses, enabling the Potomac water to be carried directly to the city, without passing through the reservoir.

From the distributing reservoir three mains, respectively 36 in., 30 in. and 12 in. in diameter lead to the city.

College Pond is crossed by a bridge of two arches of 120 ft. span, composed of cast-iron flanged pipes of 30 in. diameter.

Rock Creek, between Washington and Georgetown, is crossed by a bridge of 200 ft. span and 20 ft. rise, composed of two ribs of 48-in. cast-iron pipe flanged and bolted together, supporting iron trusses on which a roadway is carried. From 1862 to 1876 a horse car track was carried on this bridge. Since October, 1876, the passage over it of heavily loaded wagons and carriages has been forbidden.

The pipes composing the arch, and through which the water is conveyed, were at first lined with wooden staves, as a preventive against freezing, but they were shortly removed.

In one of the abutments of this bridge a water-pressure engine, built by H. R. Worthington, was placed in 1860, and operated until 1875, when it was worn out. It was driven by water from the main, and forced water to the high-service reservoir in Georgetown, a hemispherical brick structure 120 ft. in diameter and 220 ft. above tide.

Considerable trouble was had with this reservoir from time to time for several years in consequence of leaks, owing to defective arrangement of the pipes leading to and from it. It supplies that portion of Georgetown which lies more than 90 ft. above tide-level. In 1879 a steam pump of two million gallons capacity and a stand-pipe were brought into use for a high-service supply for the northwestern part of Washington.

There are 175 miles of distribution pipe, all of cast iron.

The aqueducts, reservoirs and such distributing mains as are necessary to supply the public buildings and grounds, were constructed for the United States Government.

The sub-distribution pipes for supplying the city and individuals have been laid by the authorities of the city of Washington.

The frequent changes in the administration of municipal affairs have resulted in great lack of system in the arrangements for water supply.

The present consumption of water in the two cities is 26 million gallons daily, of which the Government uses nearly 3 millions.

The cost of the aqueduct, and its maintenance to June 30, 1880, was $3,800,000, and the city of Washington had expended about $1,700,000 in addition for mains.

The population in 1880 was 147,307, and the number of taps 17,000. For the year ending June 30, 1879, the income of the City Water Department was $69,459.30, and the expenditures $82,686.08.

Capt. M. C. Meigs was in charge of the aqueduct from 1835 to 1860.

Capt. H. W. Benham, U. S. A., succeeded him.

W. R. Hutton, C. E., was Chief Engineer from June, 1862 to July, 1863, and Silas Seymour from July, 1863, to May. 1865. Several officers of the Corps of Engineers have since been in official charge of the work. Theodore B. Samo, C. E., being in immediate charge from 1865 to 1873.

The present engineer officers in charge are Lieut. Col. Casey, for the aqueduct, and Lieut. Hoxie for the city distribution.

(TO BE CONTINUED.)

Received: From John Whitelaw, Chief Engineer, Cleveland W. W., 23d and 24th reports of trustees W. W. for 1878 and 1879; from Thos. J. Whitman, Water Commssioner of St. Louis, reports of St. Louis W. W. for Nov., 1876; May, 1877; April, 1878.

There being great diversity of opinion among those interested in water-works as to the particular items of information which are of most value, Mr. Croes requests suggestions from engineers and superintendents of water-works as to the form and composition of statistical tables.

At a meeting of the Water Committee of the City Council of Salem, N. J., held on the 21st, Isaac S. Cassin, of Philadelphia, was elected engineer to supervise the erection of water-works for the city. Proposals will be invited in about a week.

ENGINEERS' SOCIETIES.

ENGINEERS' CLUB OF PHILADELPHIA.

RECORD OF REGULAR MEETING, APRIL 16TH, 1881.

The regular meeting of the Engineers' Club of Philadelphia was held on Saturday evening, President Strickland Kneass in the chair; 30 members and 1 visitor present.

Mr. C. W. Buchholz read an interesting paper, calling attention to the rapid increase, during late years, in the weight of the rolling stock of railroads, especially in the locomotive, in the concentration of enormous loads upon one pair of drivers. He described the effect of this heavy weight, when hurled at the rate of 60 miles per hour, or 88 feet per second, upon a light iron bridge. He urged the great necessity of employing competent engineers to design and build such bridges and of holding them to a rigid responsibility. He doubted the efficiency of trussed bridges with parallel chords and pin connections for spans under 150 feet long, under the present condition of large railroads using modern locomotives and running at a high rate of speed. He suggested solid plate girders and rivited arched trusses as being stiffer and more permanent. In conclusion he drew especial attention to the great care the modern locomotive imposes upon the engineer in designing the details of all bridges and in determining and proportioning their floor systems.

Notes on the sewerage of Memphis were read by Mr. Wm. Henry Baldwin, giving some personal experiences while engaged in the construction of the work and also describing some experiments and observations recently made by Maj. Humphreys, engineer in charge of the sewers, showing their present condition.

Some topographical features of Memphis were described, showing that, although situated on a bluff, it does not overlook the river, but its surface descends rapidly to a small stream of water in the interior, separating the business from the suburban and rural parts of the city. To avoid polluting this stream, intercepting sewers were placed on each side. Their location, through private property for much of their length, was described, showing how, by avoiding all angles and using curves of 100 feet or more radius, these mains were reduced, practically, to straight lines.

The Memphis sewers being intended to carry off only household waste, the adjustment of their size was shown to be so proportioned that the nearly uniform supply of water afforded a sufficient midday flow to fill the sewers at least half full every day, thus keeping them constantly flushed. Hence the necessity for the entire, and not the partial, exclusion of rain water; for its admission even from the roofs of dwellings would render this adjustment of size, and hence the daily flushing of the sewers, impossible.

The entire system is thus shown to be self-cleaning, except the upper end of the smaller branches where the water furnished by houses is not sufficient to half fill a six-inch pipe, and here the flush tank is required to discharge once a day water enough for this purpose. The operation of flushing being required only at the dead ends, it will be seen that the tanks are widely distant from each other, that their action is entirely independent and that the failure of any of them to operate would cause only local inconvenience and have no possible influence on the rest of the system.

The fact that the pipes are entirely clear has been established by passing through them metallic balls but little smaller than the sewers themselves. The velocity of flow in the mains, as determined by recent gaugings, was shown to be such that any substance, introduced into any part of the system, would be discharged into the sewer in the course of two or three hours, in fact, long before it would have time to stagnate or become foul; and this, together with the complete system of ventilation described, by which a burning piece of paper is drawn into the sewer and not blown out, shows the complete success of the Memphis system of sewerage as a sanitary work.

Mr. Chas. G. Darrach read extracts from the reports of the chemical experts on the present condition of the water supplied to the citizens of Baltimore. This water is supplied from Lake Roland, and when drawn from the taps has such a disagreeable taste and odor as to be useless for domestic purposes. One of the experts found that there was present a volatile nitrogenous substance unknown to chemistry, which he believes to have been the cause of the offensive smell and taste. Whether this organic substance is injurious to health or not he is unable to say, that being a question for physicians. The other expert thought that, as the water was taken from near the bottom of the reservoir (some 25 or 30 feet below the surface), the water needed air. Mr. Darrach advanced the same theory, and in proof stated that the surface water of Tumbling Run Dam in Schuylkill Co., when visited in 1875, was good, while that drawn from the bottom was very offensive to both taste and smell. The water taken from the Fairmount pool, during winters when the ice remains for any unusual length of time, becomes very disagreeable.

Mr. Strickland Kneass presented to the club a set of large views of the machinery for trench excavations of Mr. Howard A. Carson, of Boston, and an explanation of the same was read.

HOWARD MURPHY, Secretary

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.

This society met on the evening of the 19th, President Metcalf in the chair. In a paper on "The Sewers of Pittsburgh," Mr. Geo. H. Brown said that after the outbreak of diphtheria in August, 1877, the sewer was brought into more prominence than at any time since the incorporation of the city. In 1871 the present City Engineer Dempster had surveys made of the different water basins of the city with a view to proportioning the size of the sewers to their different necessities, and reducing the entire scheme to a system. Mr. Brown enumerated the following conditions to which a well-built sewer system must conform:

First. It should be of such size that it shall carry off all rainfall, sewage, etc., from that district or basin for which it is designed, and not larger than is necessary to meet the maximum requirements. Second. The grade, especially where a light fall can only be secured, should be perfectly straight. Third. It should be built of such shape as to secure the greatest possible velocity, especially at a minimum flow, and thus carry off all matter sufficiently quick to prevent decomposition. Fourth. The brickwork or masonry should be perfectly watertight. Fifth. The interior should be finished to a smooth and uniform surface.

The benefits to be derived from a smoothly finished interior were described, and the speaker was of the opinion that a sewer of the shape of an egg would give the best results.

Referring to the sewer on Twenty-first street, south side, he stated that through some insane idea it was made to curve into Sarah street and then into Nineteenth street, which it follows in a straight line to the river. No sane engineer would make such a location. It must certainly have been made by some promiscuous councilmanic interference, instigated by constituents who though they were subserving their own interests, when in reality they were culpably blind to them. This sewer has a circle for a cross section, when it should have been egg-shaped.

The territory drained by this sewer is about 219 acres. If a sewer 4.19 feet in diameter had been built on a straight line following Twenty-first street, the same benefits would have been derived. The loss to the city was estimated by Mr. Brown at $13,636 from the bungling manner in which this sewer was constructed. The loss to the city from the faulty construction of the Washington street sewer brought the amount up to $18,036.

The Monongahela River carries in suspension a fine silt which has been deposited during immersion over this entire area, forming a strata almost impervious to water and certainly to sewage. Over this layer there is probably fifteen to twenty feet of embankment; hence the sewers lie above this strata since none of them are over twelve feet deep. These sewers being badly built a poisonous fluid has been escaping for years, and being unable to percolate through this silt has spread laterally and vertically, leavening the entire superincumbent mass of earth, so that there is not a house in this entire territory but what incloses within its walls sewer deposit. There are also several springs located in this district, and hence the people both drink and inhale death. That the rage of diptheria occurring in 1877-79 must have had its origin in this way was shown by its appearance in the wealthy families in the East End, and points where, if investigation were prosecuted, the cause might be found to exist in a lack of a sewerage system, the nature of the soil preventing any purification by percolation, and poisoning of the springs by surface flow of water.

In regard to sewage gases the speaker said there was but one verdict—to confine them if possible, or else run the drops outside of the houses.

There are few cities in the United States better topographically situated than Pittsburgh for a thorough sewer system, and to that fact alone can be ascribed its comparative freedom from contagious diseases. It certainly owes no debt of gratitude to its early engineers, who simply carried each sewer to the river, where they left it to pour out its putrid contents where the current was most sluggish. As a result we find sewerage matter held in suspension about the mouth of each sewer or deposited along the shore, rendering the entire river front a most indescribable nuisance during the summer months.

Mr. Brown closed by stating that all attempts at sanitary reform would prove as useless as expensive until two main sewers were constructed, one parallel with the Allegheny and the other parallel with the Monongahela river, intersecting all laterals and discharging their united contents into the Ohio River where the current is swiftest. Had this plan been adoptad at an earlier date it could have been accomplished at an expense very little greater than required to build up the present system, where each sewer is carried several hundred feet further than would have been necessary. A similar plan should be adopted on the South Side. The plan may be excessive but the necessity is urgent.

Upon the motion of Mr. Dempster the discussion of the paper was deferred until the next meeting.

Mr. Diescher then made a short statement on a method for building "a fire-proof Library Building" of wood, which he claimed could be done by filling in the flooring with a composition of broken brick filling, closely around the joints and the placing of a layer of clay under the roof. He illustrated his project on the blackboard and it excited considerable interest.

THE SEWERAGE OF MEMPHIS.*

BY FREDERICK S. ODELL, C. E.

After nearly half a century of indifference to that virtue which ranks next to Godliness, and almost utter disregard of the simplest sanitary laws, it became apparent, after the deplorable epidemics of 1878 and '9, that some radical reformation must be accomplished in the sanitary condition of Memphis; acting on this conviction, and the recommendation of the National Board of Health, her representative men determined upon the accomplishment of a sanitary revolution for their town.

At that time little had been done, practically, in the way of sewerage, and that little was done by private enterprise; there were no public sewers, and the refuse and filth were delivered into cesspools and private vaults, while not a small portion found its way into the gutters of the public streets, and these during a prolonged dry season became reeking and putrescent, and emitted the foulest odors. Nor was this all. Some years ago, many of the streets were paved with Nicholson pavement, and these had very much decayed, and readily absorbed much of the liquid filth that flowed over the rotten gutters, and in course of time became so permeated with it that the periodical flushings of rain storms utterly failed to cleanse them, and they were the constant source of poisonous exhalations. This, added to the emanations of privy vaults in the rear of dwellings, and sometimes in the very dwellings themselves, in the cellars, and within contaminating distances of wells and cisterns, created an atmosphere that was doubtless among the prolific causes of the spread of contagion.

The facts here cited were sufficiently apparent to make the better disposal of sewerage a matter of imperative necessity, but the outlook for it was not a cheerful one, for at the outset the municipal commission was confronted by plans and estimates of cost ranging from one million five hundred thousand to three million dollars and upward. This amount, in the condition of Memphis, bankrupt by reason of official mismanagement and plunder, with the additional disadvantage of two successive seasons of distressing epidemic, resulting in the paralyzation of her industries and the discouragement of her tradesmen, made the possibility of raising this large amount very problematical, if not totally impossible.

During the discussions that ensued, pending the approval and adoption of some practical plan for the sewerage of Memphis, the commission sought the council of Mr. Geo. E. Waring, Jr., Sanitary Engineer, of Newport, R. I., who boldly advocated the adoption of a system of sewerage hitherto untried on an extensive scale in this country.

This system possesses the distinctive feature of employing the sewers for the single purpose of conveying sewerage, and rigidly excluding all surface and subsoil drainage; the amount of water necessary to furnish conveyance for such solid

* Read before the Am. Soc. C. E., at the annual meeting, Nov. 3, 1880.

matter as enters the sewers being introduced from another source.

The "Separate System," as this is styled, although not claimed as original, has been adopted by Col. Waring, who is perhaps its most zealous advocate in this country.

The principle, "that two outfalls, independent of each other, should be provided; one for the discharge of natural or land and surface waters, and the other for the discharge of artificial or house and soil drainage," and that "a system of impermeable drains should be provided, distinct and separate from the permeable land drains and sewers," "to carry off the house and soil drainage," was announced in 1849, by Mr. Philips, the engineer to the "Metropolitan Commissioners of Sewers," (London).

Although the recommendations based on this principle were not adopted for London, the principle itself contained sufficient merit to commend it to many eminent engineers who have from time to time reasserted the advantages of this system; and the contest then inaugurated has continued to the present day.

Among the many able champions of the "Separate System," might be mentioned John Bourne, C. E., who, in a forcible article in 1866, advocated the adoption of two systems of drains, the large to be restricted to rain-fall, and the small to house sewerage.*

But the advocates of this system have done more than merely assert its fundamental principles; they have given demonstration of the practicability of their ideas in the construction of sewerage systems in several towns in England. Among others, may be mentioned those of Reading and Oxford, also Halsted; the system in this case being somewhat modified by Mr. Edward Monson, Asso. Inst. C. E.—"The sewers being conterminous with the water supply, sluice-valves being placed at the ends of the water-mains, and the whole of the system being flushed by the discharge of water for cleansing the mains." The rain-fall from the roofs and yards only was allowed to enter the sewers.

So recently as 1876, Mr. Waring desired not to be understood as indorsing all that its advocates claim for what they call the Separate System, and stated "that to keep *all* rain-fall out of the sewers, is objectionable for more reasons than one, for no artificial flushing which can be depended on in practice can be so efficient in cleansing the sewers as the frequent introduction of a sufficient amount of rain-water."†

The difficulty here mentioned has been overcome by the application of the automatic flush-tank, designed by Mr. Rogers Field, C. E., to the head of each branch sewer, and filling these from the city water supply.

In 1879 Mr. Waring wrote: "This simple device has proved itself, both here and in England, to be entirely reliable and effective. It may safely be assumed that it has secured a reduction of the cost of drainage of small towns to one-half of what was formerly necessary."*

For the application of this system to Memphis, Mr. Waring recommended the construction of small sewers, without man-holes or receiving basins, and the placing of a flush-tank of 112 gallons capacity at the head of every branch, the limitation of the size of house drains to four inches, and the exclusion of all rain-water.

The estimated cost of this system was only about one-tenth of that of a complete storm-water system as ordinarily constructed.

This fact, perhaps, carried greater persuasive force than either the logic or eloquence of Mr. Waring, and after prolonged discussion, that developed much bitter opposition, a favorable endorsement of this system was secured, and its adoption urged by the commission. A petition for authority to raise $228,500 was granted by the State Legislature to cover not only the cost of a sewerage system, but also other sanitary work; the laying of about forty miles of subsoil drainage, and also the reclamation of the bayou, by shutting out the high water of the Mississippi by means of a dam with proper valves, and a steam pump, to pump out the bayou during high water. Even after the recommendation of the citizens commission, and its acceptance by the Legislative Council, so great was the force of general prejudice against its adoption that much time was lost, and construction delayed until the 21st of January, 1880, when work was actually begun.

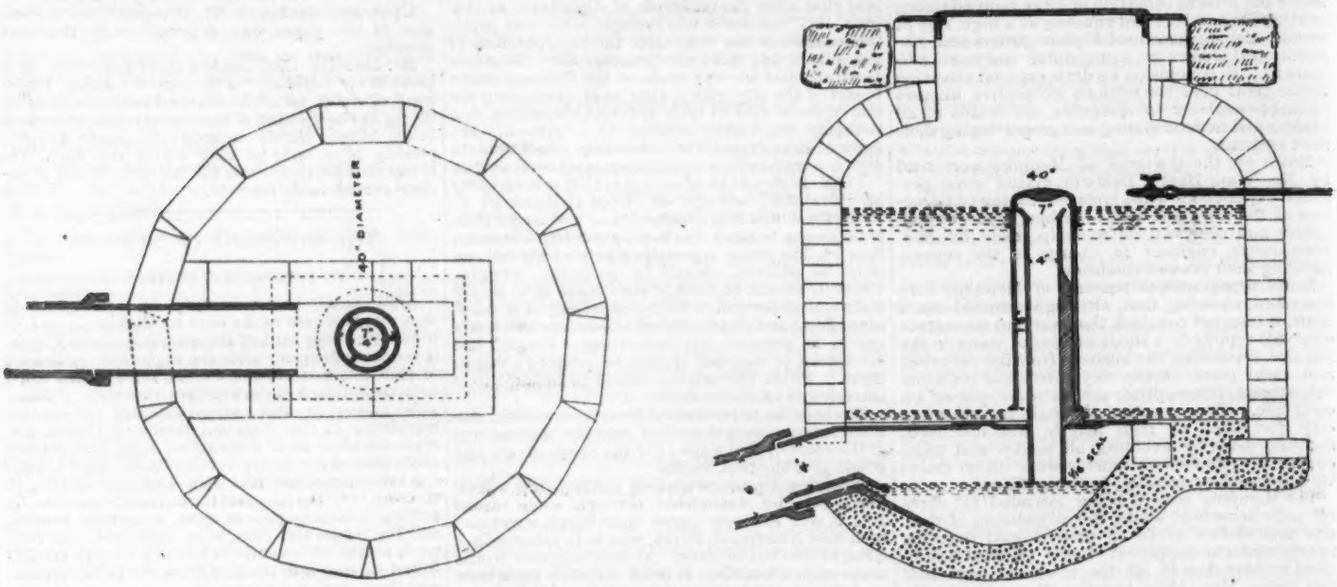
The work was done under the immediate direction of Mr. E. C. Metcalf, engineer in charge, Mr. Geo. E. Waring, Jr., being consulting engineer. The writer arrived at Memphis Feb. 20, 1880, and after a few weeks spent in locating, assumed charge of construction of a section as assistant engineer.

The main sewers were located along the bayou, and ran in a general direction parallel therewith. For about four thousand feet from the outlet, one main sewer was built of brick, of 20 in. diameter, to the junction of the two main pipe sewers that ran on opposite sides of the bayou, that on the westerly side being 15, and the one on the easterly side 12 in. in diameter; these decreased in size to 10 and then to 8 in. at the upper end.

The lateral sewers were of 6-inch pipe, except in a few cases, where an increased size was required, by reason of their greater length, the size being regulated by allowing a carrying capacity of about 280 gallons per day for each city lot of 25 ft. front, the sewers to run from two-thirds to three-quarters full.

In connection with the sewerage, the subsoil drainage received its share of attention. This was rendered necessary at Memphis by reason of its clayey formation, which prevented the infiltration of water falling upon its surface, so that subsoil water was often found in the most improbable places a few feet below the surface, and was a source of constant annoyance and inconvenience in the prosecution of the work. To provide for this subsoil drainage, ordinary agricultural drain tile, with open joints, were laid in the trenches with the sewers, and it not infrequently happened that it became necessary to lay these tile in advance of the sewers, and on a lower grade, as will be more fully explained hereafter.

The main sewers running along the bayou were located in such a manner as would best conform to the natural topography, and were carried around obstacles on curved lines whenever practicable, and thus kept at an elevation that usually avoided deep cuttings, or the building of the sewers on embankment, and as the main sewers were necessarily laid across private property, generally crossing the main streets at an angle approximating a right angle, it sometimes became necessary to carry the sewers underneath dwellings and other buildings. In low ground, when the flow-line came above the natural surface, and in some other places when suitable foundations could not be otherwise secured, a viaduct was built of small brick arches, the supporting piers being carried down to a sufficient depth to insure a stable foundation; on this viaduct the pipes were laid, and enveloped in a ring of brick-work, composed mainly of bats and broken brick obtained from a ruined building in the vicinity of the work; this was then given a coating of earth to make it secure against frost.



FIELD'S AUTOMATIC FLUSH TANK.

Great care was necessary in maintaining a true grade while laying the pipes. On account of the very small natural inclination of the bayou but very slight grades were attainable; for nearly half the length of the west side main the grade is one foot in six hundred; above that it is one foot in five hundred, and still further up one in three hundred. In order to lay the sewers carefully to this grade stakes were set in the bottom of the trenches at stations every 12½ feet, and driven to the grade of the flow-line; the pipe layer was furnished with a straight-edge of sufficient length to reach from stake to stake; this straight-edge was just so much wider at the lower end as would represent the fall for its length, and was used by placing the narrow end in the pipe it was desired to test, and the other end on the nearest stake below the pipe; then a spirit level was placed on the straight-edge, and if not found to be level, the pipe was raised or lowered until it became so.

In some cases, as at street crossings, where the sewer came so near the surface as to endanger the crushing in of the vitrified pipe sewer at times when the ground is very soft, a few lengths of iron pipe were used.

Iron pipe will also be used for the low-water outlet, and for the east side main at the bayou crossing, where the pipe is carried over on a bridge.

There are two outlets, one for high and the other for low water, and the sewerage can be turned into either at pleasure, by means of a swinging section, working in a brick chamber.

In a system of sewers like the one here described

*Engineering, Vol. 2, p. 207.

†"The Sanitary Drainage of Houses and Towns," by George E. Waring, Jr., 1876, pp. 149, 150.

*Atlantic Monthly, July, 1879, p. 61.

success depends upon keeping the pipes clear and free from deposits of every kind. To do this required the greatest care during construction, consequently a departure from the ordinary methods was adopted, and the pipes were laid from their beginning toward their outlet, the joints being cemented as the work progressed; there was thus no chance for mud and water to enter; besides this, to avoid all occasion for deposits, great pains were taken in laying the sewers to secure concentricity and smoothness of joints. For this object an adjuster was made, which by means of three india-rubber bearings lapping the joint on the inside of the pipe, and pressing outward by turning a screw, held the two pipes firmly in position until they were secured by pressing a gasket of oakum in around the collar, the gasket serving the double purpose of holding the pipes in position and preventing the intrusion of cement, that might otherwise work through and form little ragged particles, offering obstruction to the flow, and giving lodgment to small, solid matters, in time causing serious deposits.

The flush-tanks which make the separate system practicable are placed at the head of each branch sewer of about six hundred feet in length.

They are built beneath the surface of the ground, of brick masonry; the walls, four inches in thickness, in the form of a vertical cylinder drawn in at the top, and terminating with a cast-iron cover, similar to a man-hole cover, the whole resting on a concrete bottom. The syphon which discharges the tank consists of a cast-iron discharge pipe, fitted within a large pipe of the same material, and rising within the center of the tank. In operation, the tank is slowly filled by a small stream of water from the supply pipe, so graduated as to fill the tank about once in twenty-four hours, or as often as may be found necessary to flush the sewers. As soon as the tank is filled, and the water begins to drip over the outlet, the syphon is brought into operation, and the whole contents of the tank instantly discharged, and the water goes rushing down through the sewer, sweeping away such small deposits as may have accumulated since the last flushing.

Many difficulties were encountered during the progress of the work and delays were twice occasioned by the failure of the parties who furnished the pipes to deliver them promptly according to their agreement.

Subsoil water was troublesome at all times, and was always found on level ground, a few feet below the surface; at the beginning of sewers it did not amount to much, but as the laying progressed the water flowed on down through the tile that was laid in the trench with the sewers, soaking the bottom of the trench and making it soft and muddy.

In such cases the subsoil drain was laid in advance of the sewers by digging a narrow trench below the grade of the sewer. Into this trench the tile were laid and covered with boards to prevent their being disturbed while laying the pipes.

At the lower end of the sewers a great deal of water was frequently encountered and very soft bottom. Where the bottom was only moderately soft it was sometimes excavated a few inches below grade, and filled up with gravel. Where this process failed to give a firm bottom, recourse was had to piling. Saddle piles were kept constantly on hand and frequently used. They were made of boards of various length, with a semi-circular piece cut out at the top of the proper size to fit the exterior of the pipe; these were driven firmly to the proper grade, the pipes laid and cemented and the trench backfilled. After the sewer was finished and the subsoil drain laid underneath the main sewer and extended to its outlet in the bayou, these wet places became speedily drained. The writer noticed especially one of the worst of these places where the pipe-layers were constantly half way up to their knees in mud and water, where the pipes were built up for a considerable distance on piles. A few weeks afterward a portion of this was unearthed for examination, as it was confidently predicted while being laid that this part would settle, and the joints become cracked. An investigation, however, showed it to be in good condition, and what was still more surprising was to find the trench quite dry and the filling firm and hard, notwithstanding there had been rains shortly before the examination. The outlet of the tile drain showed a small stream running continuously.

The sewers were laid on an average about six and one-half feet below the surface; as but few buildings had cellars, this depth was amply sufficient.

The tile subsoil drain was laid beside the sewer in the same trench, the joints were covered with paper to prevent the loose filling from stopping the joint, they were from one and one-quarter to three inches diameter, and were provided with an outlet in the bayou.

The work was carried on until August, but comparatively little was done after the middle of June. When the writer left (June 10) about twenty miles of sewers had been laid, and so much as had been completed was in successful operation, and the practicability of the system fully demonstrated.

The advantage of this system over the ordinary system of large sewers is two-fold. It is cleaner and cheaper; cleaner because the pipes are kept constantly flushed and thoroughly ventilated; cheaper, because there is a vast difference between the cost of a large brick sewer with its man-holes and receiving basins, and a small pipe sewer with its simple fresh air inlets. The difference is very apparent when it is considered that the total cost of twenty miles of sewers in Memphis, for labor, materials, engineering, superintending and incidentals, including the two main sewers, was about one hundred and thirty-seven thousand dollars ($137,000).

With the results already achieved by this small pipe system of sewerage, it seems safe to predict that a new era has been inaugurated, and that the coming years will witness great modifications in the prevailing methods of sewerage.

ENGINEERING ABROAD.

Cochin China is giving some employment to French engineers. There are a great many "arroyos" in the country, which have to be drained. Large canals will give navigation facilities. A railroad from Saigon to Phuna-Penk will doubtless soon be constructed. The cost is estimated at only five million dollars, but this sum, in a country of cheap labor, will go a great way.

Hamburg is so badly off for good drinking water that twenty filtering basins have been put on the Upper Elbe, and the total cost will be eight million francs.

It has been remarked by recent travelers in Germany that whatever may be the economic evils under which the country is suffering, yet there has been a great unification of thought, and that the people have become "a single people of brethren." The German civil engineers shew something of the same spirit of unity, and the "Association of German Engineers," is recruited among the military and civil branches, etc. There are only seven polytechnic schools in the Empire: Berlin, Hanover, Aix La Chapelle, Munich, Dresden, Carlsruhe and Darmstadt. Seven or eight years study are requisite to pass the State examination. Whatever advantages the system of high theoretical education may possess, it must also be admitted that the English system, where a young man was "bound" to a civil engineer, had also great advantages—so much so that it is intended to merely modify it.

Among the managing committee of the Engineers' Club of Rio Janeiro we find the names of Messrs. Dr. Morsing, H. Hargreaves, C. P. Mackie and Commodore Mayrinck.

THE UPPER EAST RIVER BRIDGE.

The contract to build the bridge between this city and Ravenswood, L. I., crossing Blackwell's Island, has been let to Messrs. Clark, Reeves & Co. The contractors are now busy on the iron work for the foundations of the piers. It is expected that the bridge will cost $5,000,000, and Dr. Thomas Rainey, President of the bridge company, says that money enough has been raised to warrant beginning the work. There will be four piers, one at Ravenswood, another at the coal dock on Blackwell's Island, a third on the west side of the Island, and the fourth on the New York side, between Seventy-sixth and Seventy-seventh streets. It is intended that the New York approach shall form a junction with the railroads in the Fourth avenue tunnel, a mile and a quarter above the Grand Central Depot, and that the Long Island approach shall connect with a spur of the Long Island Railroad. The bridge will be 74 ft. wide, and will be aranged for two sidewalks, two carriageways, and two steam railroad tracks. The span over the water from Ravenswood to Blackwell's Island will be 618 ft., that across the island 700 ft., and that over the river to New York 734 ft. Each pier will rest on bed rock, the dip of whose strata at all points is nearly vertical. The Ravenswood pier only will stand in the water, and a coffer-dam will be placed in position next week to prepare the rock for its reception. One corner only of the New York pier will touch the water. The roadway will be 154 ft. above the river at high tide, and 160 ft. at low tide. A commission to appraise the land needed on Blackwell's Island has been appointed by the Supreme Court. Several of the old directors have died, and a reorganization of the Board, Dr. Rainey says, will soon be effected. The work will be a private enterprise, and it is proposed to complete it is three years.

DIRECTORS OF PUBLIC COMPANIES AS CONTRACTORS.

The United States Supreme Court recently rendered a decision which strikes at the root of an evil that has tainted many large enterprises in this country. It has been a favorite trick of one set of men controlling the majority of the stock of public companies to contract with themselves for supplies to be furnished, thus making moneys which ought to have been distributed as dividends among the great body of shareholders appear in the expense accounts, although they really wandered into the pockets of the "ring." The facts in the case decided a few days since fully illustrated this practice, which in one or the other form has been, and is now, frequently used to fleece "outsiders." It appears that in 1868 one Thomas Wardell, the appellant in the present suit, obtained from Oliver Ames, then President of the Union Pacific Railroad Company, a contract to occupy and work the coal lands belonging to the company along the line on very favorable terms. Soon afterwards a stock company was organized, under the title of the Wyoming Coal and Mining Company. Of this organization Wardell and a number of the directors of the Union Pacific Railroad Company were the leading stockholders, and to it Wardell transferred his contract without consideration. In 1874 the officers and agents of the railroad company, by order of its directors, seized the entire property of the company, and they have held and used it ever since. Wardell sued under the contract for damages from such seizure, and from the attempted abrogation of the contract. The lower courts entered a decree against him, and, in his opinion confirming it, Justice Field takes a very decided stand as to the legality of such transactions. He holds that all arrangements by directors of railroad companies by which a new company is formed as auxiliary to the original one, with the understanding that the directors of the original company, or some of them, shall take stock in it, and then that valuable contracts shall be given to it, in the profits of which the directors, as stockholders of the new company, shall share, are so many unlawful schemes to enrich their promoters at the expense of the stockholders of the original company. He states that they will be condemned whenever they are brought before the courts for consideration.

Railroad companies and mining enterprises seem to have been particularly fertile in producing this particular class of fraud, but if we can judge from the number of suits pending in different parts of the country, in which attempts are being made to prove that stockholders have been cheated in this way, the time is approaching when unscrupulous directors must look for some other method of appropriating the lion's share of profits. Stockholders will refuse to sanction or connive at the private contract system now so prevalent, and we may expect to see public tenders become more popular.—*Iron Age, April* 28.

THE PANAMA CANAL.

WASHINGTON, April 26.—A letter received from Commander Lull, of the Navy, at San Francisco, says that while at Panama recently, awaiting the arrival of the Wachusett, he inquired in detail into the progress of the French canal project. He found only a few native laborers at work, the construction work not having begun, and from personal examination he became convinced that a tide-water canal was utterly impracticable.

NOTES.

HIGH TIDES.

Where the tide moves in all at once from the ocean the phenomenon is called an *eagre* or *bore*. According to Dana, the most perfect examples are found at the mouth of the rivers Amazon, Hoogly (one of the mouths of the Ganges), and Tsientang, in China. In the case of the last-mentioned river, the wave plunges on like an advancing cataract, four or five miles in breadth and thirty feet high, and thus passes up the stream, to a distance of eighty miles, at a rate of twenty-five miles an hour. The change from ebb to flood tide is almost instan-

taneous. Among the Chusan Islands, just south of the bay, the tidal currents run through the funnel-shaped frith with a velocity of sixteen miles an hour. In the eagre of the Amazon, the whole tide passes up the stream in five or six waves, following one another in rapid succession, and each twelve to fifteen feet high.

HUDSON TUNNEL MORTGAGE.

By an instrument dated April 1, the Hudson River Tunnel Company have mortgaged all their property of every description to the Central Trust Company, as trustees, to secure the payment of 10,000 bonds of the par value of $1,000 each, to be known as "first-mortgage construction bonds," which are to be issued as the work of completing and equipping the tunnel under the Hudson River progresses. The bonds are payable in the year 1911, with interest at 6 per cent. A clause of the mortgage recites that an indebtedness of $300,000 has already been incurred by the Tunnel Company, and that $9,700,000 more are needed to secure the necessary right of way and complete the undertaking. A copy of the instrument, which is quite voluminous, has been recorded at the register's office.

ELEVATIONS OF MASSACHUSETTS TOWNS.

A profile map of the Boston & Albany road and its branches has been executed recently by W. H. Russell, C. E., giving the elevations, grades and distances from Boston to Albany. Horizontal distances are on a scale of $\frac{1}{4}$ an inch to the mile, and vertical are 600 feet to the inch. Pittsfield is 1,013 above sea level, Hinsdale 1,431, Washington 1,437, Dalton 1,190, Shakers 1,114 and Richmond 1,047. The grade from Dalton to Hinsdale is 75 feet to the mile, between Washington and Becket 78, and between Becket and Middlefield 82.

MASSACHUSETTS BOUNDARY LINE.

Roger Sherman, of Pawtucket; William S. Haines, of Providence, and George A. Wilbur, of Woonsocket, are the Rhode Island commissioners to join with three from Massachusetts in settling the boundary dispute between the States. The eastern line is settled, but the northern has been in dispute for over 200 years, and an effort will now be made to finally fix it.

CREOSOTING WOOD AS PROTECTION AGAINST TEREDO.

The following is a copy of a letter addressed to Mr. Edward R. Andrews, proprietor of the creosoting works at Elizabethport, by Brevet Lieut. Col. William Ludlow, Captain of Engineers, U. S. A., under date of March 31, 1881:

"In the summer of 1878 you sent me, at my request, four blocks of yellow pine, two creosoted in accordance with your method, and two in their natural condition, for the purpose of testing the efficacy of the treatment to protect timber from the teredo in the waters of Delaware Bay, near Cape Henlopen.

"The description of these blocks was as follows:

No.	Condition.	Dimensions.	Weight dry.
1	Natural.....	5″×5″×22½″	15½ pounds.
2	Creosoted.....	5 ×5 ×22¾	21 "
3	Natural.....	5 ×5 ×22¾	14½ "
4	Creosoted.....	5 ×5 ×22¾	22 "

"After being weighed the blocks were bolted together in pairs and placed in the water on Aug. 9, 1878, near the end of the Government pier in the Delaware Breakwater Harbor. Nos. 1 and 2 were submerged to a depth of 19 ft. below low water, and 3 or 4 ft. above the bottom. Nos. 3 and 4 were placed about 3 ft. below low water level. After remaining in the water for 22 days, they were taken up and reweighed to ascertain the amount of water absorbed by each, with the following result:

Nos.	Weight, dry	Weight, wet.	Gain.	P. c. of absorption.
1	15½ lbs.	19 lbs.	3½ lbs.	0.226
2	21 "	22 "	1 "	0.048
3	14½ "	17½ "	3 "	0.207
4	22 "	22 "	½ "	0.023

"Averaging the couples:

"The natural blocks gained 21.6 per cent.

"The creosoted blocks gained 3.5 per cent.

"The blocks were reconnected and put back in the water the same day, Aug. 31, 1878. They remained undisturbed until Jan. 6, 1879, when the heavy ice, rapidly filling the harbor, caused apprehension that it might carry them away. Several small holes where the teredo had entered were observed on the untreated blocks.

"As soon as danger from the ice was past, the blocks were returned to the water March 18, 1879, and remained until Sept. 16, 1880, when it was observed that the iron rod to which they were attached was nearly destroyed by corrosion.

"Having been dried the blocks were again weighed as follows:

No.	Original weight.	Final weight.	Loss.	Percentage.
1	15½	11	4½	29.0+
2	21	21	0	0.0
3	14½	10	4½	31. +
4	22	22	0	0.0

"Average loss of natural blocks, 30 per cent.

"The total time of exposure to the teredo was 698 days. In addition to the loss of weight, which is probably less than the total amount, since the interior cavities had not been entirely deprived of water, an examination of the blocks showed that the natural ones had been largely destroyed by the teredo, while the creosoted ones were perfectly sound. There were visible on the ends of these sight punctures where the young worms had apparently attempted to bore in without success.

"The sound condition and the absence of any loss in weight in the creosoted blocks, after having been dried, showed that the oil had protected the wood from the teredo, and resisted any chemical or mechanical tendency of the water to remove it —a point with regard to which doubts have been felt."

THE IRON TRADE.

WHEELING, W. Va., April 22.—The iron manufacturers of this vicinity have kept their establishments going almost uninterruptedly all winter and spring, and are now in full blast. Owing to the high price paid for ore last season, pig metal has been made without much profit. It can be bought now about as cheap as it can be made, and manufacturers have declined ore contracts this season. The nail mills are well supplied with orders, and the demand is good, considering the weather this spring. It promises to become more pressing from this time on. The early completion of the Hempfield railroad to the Connellsville coke fields will give a decided impetus to the blast furnaces hereabouts.

DEWS AND FOGS.

In a paper on dews and fogs, Herr Dines says that morning fog along a river course arises when the water is warmer than the air over it, the evaporation going on more quickly than the vapor can be carried away, and is, therefore, condensed and spread as fog. The evening fog on moist low-lying meadow land he attributes to a lowering of the temperature of the grass surface by radiation, and a consequent condensation of the aqueous vapor in the lowest layers of the atmosphere.

INDIA RUBBER.

A report by Dr. H. Trimen, of Ceylon, on India rubber, states that the plant which produces the Ceara rubber is very hardy, and will grow in a dry, rough soil and in a moderately dry, hot atmosphere, while the Para and West India rubber plants require a rich alluvial soil and a constantly hot, moist atmosphere. The tree grows to a height of about 30 feet, and has a dense rounded crown. In two years it attains a diameter of 4 or 5 inches, when it may be tapped. The cultivation of this tree will reduce the price of rubber to a reasonable rate.

RISKS FROM LIGHTNING.

Statistics show that since 1854 there has been an increase of risk from lightning in various parts of Germany, Austria and Switzerland, while there is no corresponding increase in the number of thunder-storms. Herr Holtz, who has been investigating this matter, inclines to the belief that the causes for the greater liability of danger from lightning are to be sought in the changes produced of late by man on the surface of the earth; such as the clearing of forests, the increase of railroads, and the great use made of iron in the construction of houses.

A MEASURE FOR ELECTRIC ENERGY.

For controlling the action of electric-light machines, M. Debrun, says *La Lumière Electric*, uses a very simple sort of measure of electric energy. It is a very long magnetizing coil fixed horizontally, the core—half iron, half copper—forming one of the sides of an articulated parallelogram. Under the dynamic action of the coil, the core enters it more or less, according to the strength of the current, and a counter-weight serves to pull the core back. An index finger on the rod is displaced with it, and moves before a scale graduated in tenths of webers, indicating at any time to the man in charge the intensity of the current furnished. M. Debrun has noticed that a displacement of the index on the scale suffices to show how the carbons burn.

DISTINGUISHING AMBER FROM COPAL.

Some of the ways of distinguishing amber from copal are thus given in *La Nature:* "Copal is yellow, of a more or less deep tint, but uniform throughout, and has yellow points like sulphur on its surface. Amber, in a fragment of 12 centimeters in length, will show a variation of shade. Amber when rubbed will yield a strong aromatic odor; its imitations will not. Amber may be bent after being smeared with tallow and heated; the imitations will not bend. Amber may be cut, sawed, rasped, or polished, but cannot be cemented or soldered like copal. The density of amber is 1.09 to 1.11, that of copal is 1.04.

AN OLD ELECTRIC MOTOR.

In the year 1839 there was a printing press operated in this city by electricity. The motor consisted of a working-beam about four feet in length; from one end descended the connecting-rod to the crank. A rod from the other end terminated in a soft piece of iron, which fitted loosely in a coil of insulated copper wire. The battery consisted of a trough of wood about three feet long, two wide, and one deep, and was hung with alternate sheets of copper and zinc. These were arranged so that they could be raised from the bath of dilute sulphuric acid when the machine was idle. When the current was on the piece of soft iron was drawn into the coil; the current was then broken, when the fly-wheel carried the rod until the current was again engaged. The extreme end of the working beam would lift about 130 pounds.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

WE will be very much obliged for any notes sent us—either newspaper clippings, or otherwise—on the subject of water supply, the construction of new works, new engines; anything that is of value and interest to our readers. We cannot take all the papers in this country, and we cannot write or call upon all the water-works' people. We hope our friends will send us all the NEWS they can find.

John Kershner has been awarded the contract for the pumping-house, etc., of the Springfield, O., Water-works.

Peabody, Mass., has appropriated $85,000 for a pumping-station to provide the town with a high-service water system.

The Chester Pipe & Tube Company, a new organization, has bought property of the Chester Tube & Iron Works, at Chester, Pa. It will be a branch of the Potts Brothers Iron Company.

Messrs. Goodhue & Birnie, of Springfield, Mass., have been awarded the contract for the construction of the Lee, Mass., reservoir, and pipe laying to the village. The reservoir head will he 190 ft. above the village park. The pipes are all to be wrought iron, cement lined, with a 10 in. main. The contract price is $30,000.

The St. Charles Water Company, St. Charles, Mo., has contracted with Frank H. Pond, of St. Louis, Mo., to furnish them with two Worthington high-pressure compound pumping-engines for their water-works. The combined pumping capacity of these engines will be about 2,500,000 gallons per day. The works are expected to be in operation early in the fall.

At the meeting of the Chicago City Council on Monday evening last, Alderman Burley offered the following: *Resolved*, That the Legislature of the State be requested to submit to the people of the State an amendment to the constitution of the State, authorizing the city of Chicago to issue $5,000,000 of bonds of the city of Chicago, for the purpose of extending its water-works and of obtaining a sufficient supply of pure water, which was referred to the Committee on Judiciary.

Messrs. Frick & Co., of Pittsburgh, are preparing to lay four miles of 12-inch cast-iron pipe to convey water from the Youghiogheny River, at Broadford, four miles

back to "the Summit," for supplying their coke works. The water will be pumped into a reservoir on a high hill near the river, whence it will run by gravitation to the desired points. The engine for pumping the water into the reservoir will have a capacity of 3,000,000 gallons per 24 hours, and is being made by Cope & Maxwell, of Hamilton, O. The pipe, made by R. D. Wood & Co., Philadelphia, is being delivered.

CHICAGO, April 25.—The health officers have declared the lake water to be so charged with organic impurity as to be fit for drinking only after being thoroughly boiled. This is the result of the flood, which has increased the current of the river to such a force as to carry all foul and decaying matter far out into the lake. To increase the impurity of the stream tugs have been kept steaming up and down the river with drags so as to loosen the débris at the bottom in order that the channel might be deepened by the swift current. This inconvenience will last only a couple of days. If any city in the world ought to have an abundant supply of pure water it is Chicago.

Last Saturday the Cleveland, O., Water-works Board for 1881 held a special meeting for the purpose of opening bids for pipe, but before taking that action the new board organized. Mr. W. H. Lutton was again sworn into duty, and Mr. Truman Denham was re-elected president. All the officers of the department were re-elected to their several positions, as they deserved to be. The bids for water-pipe for the ensuing year covered all pipes that are to be used from three to twelve inches in size. The contracts were awarded to the Lake Shore Foundry, of Cleveland, their firm furnishing the lowest prices. The other bidders were Dennis Long, of Louisville, Ky.; R. D. Wood & Co., Philadelphia; Drullard & Hayes, Buffalo, and the Newport Iron and Pipe Works. It is estimated that $40,000 worth of pipe will be purchased and laid this year.

THE USE OF METERS.—In an exhaustive article in the Brooklyn Daily *Times* of the 9th inst. the following superintendents of water-works testify as to the value of water meters: Mr. Wm. Carr, Jr., of Fall River, Mass., stated that the "meter system is the only one that should be adopted in the furnishing of water," and that the cost for private houses is "$13.50 and expenses." It costs $3 to $5 to set a meter. He thinks that the people of Fall River are well satisfied with meters. Mr. E. B. Weston, Engineer in charge of the water-works of Providence stated:

I would recommend the introduction of the meter system in all cities, because the water supply is more or less limited everywhere, and the use of meters, in my opinion, is the only way to check waste and keep the supply within proper bounds. I think the use of meters makes the water cheaper to consumers. It lessens extravagance while not affecting the quantity needed for necessary purposes. It affects the revenue favorably, and we find by statistics that the use of meters in the city tends to make the consumption much less in proportion to population than where none are used, proving that it compels consumers who are obliged to pay for all they use to be more careful. The consumer pays for the meter. I consider the meter system as tending to make a great saving of fuel, wear and tear, etc., of pumping machinery.

Mr. E. A. Grant, Secretary of the Board of Water Commissioners of Pawtucket, said: "I think the meter system the only proper way to sell water, especially when there is more than one faucet used." From 900 to 1,000 meters are in use in Pawtucket. Mr. Grant shows from his books that it is a fallacy to suppose that the application of meters makes the water more expensive to the poorer class of people of large cities.

In Worcester, Mass., Mr. Frank E. Hall, Superintendent of Water-works, said: "We favor the use of meters and encourage their adoption all we can." Worcester has nearly 4,000 meters in use.

From the proof-sheets of the forthcoming report of the Commissioner of Public Works of Chicago we learn that "the whole quantity of water-pipes laid during the year 1880 was 87,243 ft.—16½ miles; of hydrants put in during the year, 177; stop-cocks, 125; new meters, 135; water-engines connected to elevators during the year, 57. At the pumping-works, North Side (four engines), the total quantity of water pumped during the year 1880 was 12,354,008,905 gallons. The daily average was about 33,250,000 of gallons (nearly 3,250,000 per day more than in 1879). During the month of June, 1880, the daily average was about 36,250,000. At the pumping-works, West Side (two engines), the total quantity of water pumped during the year 1880 was 8,648,673,000; the daily average was nearly 24,000,000 gallons. During the month of August, 1880, the daily average was 26,500,000. The total quantity of water pumped at both pumping-works, during the year 1880, was 21,002,681,905 gallons, an average of over 57,000,000 per day, and during the month of July the daily average was nearly 62,000,000. The expense of running the North Pumping-Works during the year was in all $68,737.84; the West Pumping-Works, $44,555,41. The cost of pumping the water at North Pumping Works in 1871, per 1,000,000 gallons, was $11.31; in 1875, $10.81; in 1880, $5.68. The cost of pumping the water at the West Pumping-Works in 1880 was $5.15. The entire cost of the whole water system of the city up to December 31, 1880, was $8,802,725 10, as follows: Total income from water-rents to December 31, 1880, $11,200,158.61; total operating expenses and maintenance to December 21, 1880, including interest on the bonded debt and bonds canceled, $9,434,190.93; surplus of income over operating expenses and maintenance, $1,765,967.68. Two brick tunnels were built under the river during the year, in the extension of water mains, to wit: At Harrison street, for 36-inch water-pipe, costing $7,883.50; at Clybourn place, for 16-inch water-pipe, costing $6,875.42.

STREETS, DRAINAGE, ETC.

THERE are miles and miles of sewers, large and small, to be built this season. Will city engineers please to send us the NEWS about them, when they are to be let, etc., and thus gratify their own desire "to do good" and at the same time please the multitude of eager contractors that look to this paper each week to bring them glad tidings of "something to do."

Messrs. Johnson & Wilson, cement manufacturers, have booked a contract with Mr. Mathew Baird for 4,500 bbls. of Saylor's Portland cement, for use in the construction of the large sewer on West street, in charge of the Department of Public Works, New York.

The Sewer Committee of North Adams, Mass., are to be called together in a few days for organization, and also to see about beginning the work on the main sewer, for which the town appropriated $17,000.

At the meeting on Monday last of the Chicago City Council a communication was received from the Commissioner of Public Works containing an order allowing him to purchase sewer pipe at the lowest price obtainable without advertising, the price paid to be at least 60 per cent. below card rates. A motion to pass the order was lost by a vote of yeas, 23; nays, 7.

Chicago street work for '880 was as follows: Streets paved and improved, 96,956 feet, as follows: With wooden blocks, 72,234 feet; macadam, 13,152; stone, 1,036; graveling, 1,785; oak planking, 1,035; curb wall and filling, 6,921; curb stone and filling, 793; total, 18 1916-5280 miles, or 96,956 feet, costing for the city's part $145,347.75; and by local assessments, $539,921.01; total, $685,268.-76. About forty miles of sidewalks were built during the year 1880, of which about thirty-eight miles were built of wood and two miles of stone or concrete. Sixteen hundred and eighty-three miles of street cleaning was done by contract during the year 1880, at $26.50 per mile. Three hundred and eighty-five miles of unimproved streets were graded and otherwise worked upon during the year 1880. Nine miles of macadam and cindered streets were repaired. The whole amount expended during the year 1880, for street repairs and cleaning, was as follows: In South Division, $60,-641.51; in West Division, $72,649.35; in North Division, $24,532.41; total, $157,823.27. The whole amount of sewerage in Chicago put in during the year was 79,128 feet, nearly fifteen miles, as follows: In West Division, 6.98 miles; South, 6.11; North, 1.89; total, 14.98 miles. The amount paid out for constructing same was as follows: In West Division, $95,151.67; South, $56,365.50; North, $28,008 81; total, $179,525.94. There was also paid out for repairs of sewers during the year $8,644.21, and for cleaning sewers, $25,561.48. The number of catch-basins built was 271; number of manholes 554. The whole number in the city Dec. 31, 1881, was: Catch-basins, 10,062; man-holes, 11,953. Whole number of miles of sewerage in the city December 31, 1880, 337¼ miles. Chicago is the fourth on the list of cities as regards population, and seventh as regards age, occupies the first place when we come to consider the linear feet of sewerage, finished and in use, per head of population. Fullerton avenue conduit cost $12,766.76 during the year. The entire original cost of the Fullerton avenue conduit was $566,515.13.

BRIDGES.

WILL the county surveyors, city engineers and highway bridge builders please to send us every item of NEWS respecting bridges that they can obtain, from personal knowledge or from newspapers. It will make a great many readers of this column happy each week, even if they cannot get a contract.

The amount expended for repairs of bridges and viaducts in Chicago during the year 1880 was $61,847.85.

The engineers on the New Albany and Louisville bridge will soon have profiles and specifications ready for contracts, when the work will be let.

ASHTABULA, O., April 25.—The county commissioners were here the other day looking up the proposed site of the wagon and foot bridge extending from the foot of Bank street across to Fargo farm.

A petition for a bridge across the north fork of the Miami River on the county road, leading from Lisbon to the National Road, was placed on file at the last meeting of the county commissioners, Springfield, O.

The selectmen of Great Barrington, Mass., to whom was referred the matter of a new bridge at Van Deusenville, will probably build it of iron this summer. It is proposed to be a single span, 100 feet long.

The Louisville, New Albany and Chicago bridge over the Wabash at Mt. Carmel is all completed except the draw. This will be put in this week. The bridge has been entirely reconstructed, and is said to be one of the best that spans the Wabash River.

The bridge which is to span the tracks of the Fitchburg Railroad on the line of the Massachusetts Central at Stony Brook has at last arrived on the ground, and a large force of workmen is employed placing it in position, which operation will take about a fortnight.

MOLINE, Ill., April 21.—This city is completely shut out from the north, east and south by railroad connections. The last link is broken. One of the piers of the Peoria & Rock Island bridge at Milan was washed out this evening. It was over this road that all the Chicago, Rock Island & Pacific Railroad trains came into Rock Island.

The commissioners of Summit County, Ohio, went to Cleveland Tuesday, the 12th, to sign the contract with the Massillon Bridge Company, for the joint bridge to be constructed over the Cuyahoga River at Brecksville Station. The Cuyahoga County Commissioners signed on the preceding Monday, and it is understood that work on the bridge will be commenced at once.

W. C. Irwin, Civil Engineer and Engineer of Bridges of the Bee Line and I. & St. L. railway, informs the Indianapolis *Journal* that within five months he expects to have built on the I. & St L. railway, 1,100 feet of iron bridges, including the White River & Wabash; also 600 feet feet of Howe truss bridges, which will put the bridging in first-class shape on that line.

Messrs. Riter & Conley, of Pittsburgh, manufacturers and builders of iron mill buildings, roof frames, bridges, boilers, oil tanks, blast furnaces, and all kinds of heavy iron plate work, have purchased additional property, and are now engaged in tearing down the old buildings on the ground, preparatory to erecting a new shop. When the work is completed the firm will occupy, with yard room, fully one and a half acres of ground.

The loss by the destruction of bridges alone, in towns and country—the property of corporations, municipalities and private owners, some of them strong and costly structures—that have been swept away by the recent and present floods, throughout the Western States, is something enormous, reaching hundreds of thousands of dollars; and this loss is seriously aggravated by the consequent interruptions to transportation. Nebraska, Dakota and Northern Illinois have been especially unfortunate in this respect, and Iowa and Wisconsin have been serious sufferers.—*Chicago Evening Journal.*

PRICE OF CEMENT.—The commissioners at Youngstown, O., on the 25th, opened the bids for furnishing the cement for the Hazelton bridge. They were as follows: Andrews, Hill & Co., Akron cement, $1.35 per barrel; $1.25 per sack, same amount. George Canfield, Louisville cement, $1 20 per barrel; Akron, $1.30. Aaron Harber, Akron, $1.35 per barrel. A. B. Brownlee & Co., hydraulic cement, $1.60 per barrel; sacks, same cement, 300 pounds, $1.35; Louisville, $1.20 per barrel, $1.10 in sacks. The contract will probably be awarded to George Canfield for Akron cement.

The third viaduct over the tracks of the different railroads which, running from the Union Depot westwardly, divide St. Louis, Mo., into two parts, was completed last week on East Jefferson avenue. It is a substantial and tastefully ornamented structure, consisting of stone approaches and nine iron spans; length of the bridge, 950 feet. The roadway is 35 feet wide and is built of treated gumwood block pavement; the sidewalk on each side is 10 feet wide; total width of bridge between railings, therefore, 55 feet. The cost of the bridge, exclusive of the necessary reconstruction of the adjoining streets, was $80,000. The work was executed under the Street Department of that city, and was designed and superintended by Mr. Carl Gayler, the engineer in charge of highway bridges of St. Louis.

County Surveyor Bowen and City Engineer Graham, by appointment of the County Commissioners, recently made an examination of the State Street Bridge in Columbus, O., and reported as follows: By your request, we have examined the bridge over the Scioto River on State Street, in this city, and make the following report: The bridge is of the "Bow-string" type, wrought in iron, three spans 120 feet each, one roadway 18 feet wide, height of arch 12 feet; two foot-walks 5 feet each. The arches are made of 6-inch channel bars and ⅝-inch plates riveted together, and have a sectional area of 13½ square inches at the center or crown, and 18 inches at the foot. The chord for each arch is made of two bars 5x⅝ inches, which have a sectional area of 7½ square inches. These bars have been swedged down at the ends to 1⅝ inches round where they pass through the heel of the arch, and have a sectional area of only 4 inches. The web members vary according to their position, and are in excess of the other parts of the bridge. The floor beams are 9 inches deep, 3 inches wide on head and ⅝-inch web. These beams are of a length equal to the width of the bridge, including the footwalks, and are suspended to the under side of the chords and connected with the web system, and trussed with two ¾-inch iron rods under the roadway. There are no plans, specifications or contract on file to show what the bridge was intended to be. The only record shows that it was built by the King Bridge Company of Cleveland in 1870, and cost $13,083. Whether this amount is too large or too small is not our business to discuss. It is apparent, however, that the bridge is not what it should be for that location. The safety of the bridge, for the public whose business requires them to use it, is the question to be determined. The weight of one span of the bridge (from measures taken) is estimated at 96,000 pounds. The weight of a two-horse team and its load, as hauled on the streets, is about 9,000 pounds. Assuming that five teams may be on one span at the same time, equal to 45,000 pounds on roadway, to which should be added 5,000 pounds for pedestrians on sidewalks, making a total load of 50,000 pounds (which is only one-fifth of what should have been assumed in making the original plans for the bridge), the weight of the bridge and its load is 146,000 pounds—one-half of which, or 73,000 pounds, must be sustained by one arch and its chord, and develops a strain of 98,280 pounds at the foot of the arch and 91,-250 pounds at the crown, and the same in the chord throughout its length. Comparing these strains with the sectional areas and we have, per square inch of section in the center of the arch, 9,607 pounds; in the foot of the arch, 5,460; in the chord where full, 12,166; in the chord where reduced, 22,812. In these comparisons there seems to be large discrepancy in the amount of

materials intended to meet the resultant forces that come upon the structure. The strength of a structure is its weakest point, and in this case the greatest strain per square inch shows the weak points in the bridge, which are at the crown of the arch and end of the chord, where the metal is strained very nearly up to its elastic limit, and it is therefore only a question of time when it will ultimately fail, and cannot be regarded as safe at any time. The overhead bracing is very imperfect and badly sprung, and gives but little support to the arches. We would, therefore, recommend that it be removed and a better bracing substituted. We also suggest the construction of a stirrup to pass around the heel of the arch and be connected with the full chord bars, thus restoring the metal that should have been retained in the construction. It will not be possible, by any amount of repairs, to make a very good bridge out of the old one, but the repairs suggested will more nearly equalize the resistance to the forces and materially improve the bridge, and in our judgment is the best and only thing to do, and should be done without delay. Plans and specifications for the proposed improvement are herewith submitted. Respectfully,

B. F. BOWEN,
County Bridge Engineer.
JOHN GRAHAM,
City Engineer.

RAILROADS.

Arrangements are being made to let out the contract for extending the East Alabama & Cincinnati road. The road has been recently purchased by a New York company, which has the money to build.

Surveyors left Cedar Rapids last week to run a line for the proposed Ottumwa extension of the Chicago, Milwaukee and St. Paul Railway, and work on the Council Bluffs through line will be commenced soon with a large force of men.

The bids for building the first fifteen miles of the Wabash, from Des Moines, Ia., were opened on Friday of last week. There were a large number, and they have been sent to the Wabash headquarters for final decision.

A Mt. Vernon (Ill.) dispatch says: "The surveyors of the New Albany Air Line finished the survey of that road up to this place April 18. The road will soon be built, and will connect New Albany, Ind., with this city, and use the Louisville & Nashville line from here to St. Louis."

The Dominion Government engineers have been instructed to make a survey of Hawee Pass through the Rockies, with a view to running the Canada Pacific Railway through it instead of the Yellow Head Pass. If the change is made it is said that a survey of 200 miles in length of the line will be saved.

The principal movers in the extension of the Pittsburgh Southern Railroad from the Pennsylvania State line to White Sulphur Springs, W. Va., held a meeting in Pittsburgh this week, and elected James H. Hopkins president. The company will issue their mortgage bonds in a short time, and promise to begin work on the extension, which will be 300 miles long, as soon as possible.

KENTON, April 22.—The engineers of the Chicago & Atlantic Railway are now engaged in running a line over the old grade from this point to Marion. Mr. H. P. Hepburn, the engineer in charge of the Eastern Division of the road, has moved his family to this place from Cleveland, and preparations for the early commencement of the work of construction are going forward, and the contracts will soon be let and the work of building commenced and pushed with energy to completion.

"CHEEKY."—The Manhattan Elevated Railway Company on the 25th submitted to the Mayor, Comptroller and Corporation Counsel, a statement of its financial condition, for the purpose of securing their co-operation in a measure for relief from taxes. The statement sets forth: Gross earnings, $5,200,000; operating expenses, $3,380,000; interest on bonds, $1,364,080; taxes, $650,000; total, $5,394,080; deficit, $194,080. The company, therefore, prays to be relieved from paying any part of the arrears of taxes, otherwise the company will be bankrupt.

The following communication on the same subject was received by the Mayor, Comptroller and Corporation Counsel from the Manhattan Railway Company on the 27th:

"GENTLEMEN: In certain comments made by the city newspapers on the communication submitted to you by this company, dated April 25, in regard to relieving it from excessive taxation, the idea is sought to be conveyed to the public that the bonded debt of the elevated roads is greatly in excess of their original cash cost. We wish to state to you, in an official manner, that such is not the case. The cash paid for building and equipping the elevated roads amounted to considerably more than the entire issue of bonds now outstanding against them; and competent engineers tell us that the roads could not be duplicated to-day as they stand, except at a largely increased cost in cash over the amount originally paid for them.

"Very respectfully,
"ROBERT W. GALLAWAY, President."

So far as yet appears, the whole outcome of the Lesseps business is an operation by virtue of which an American guarantee of the Panama Railway is to be acquired by a knot of French speculators. There is no evidence whatever that any work is doing toward the cutting of a canal.—*New York World.*

NEW PROJECTS.

A new Court House for Lima, Ohio, is among the possibilities of the near future.

An Ottawa dispatch says it is understood that the syndicate will commence operations on the Canadian Pacific Railway on May 15.

A cotton exchange building, which is not to cost more than $150,000, and which is to be four stories in height, with an attic or Mansard, with elevator, shafts and stairways fire-proof, will be erected at New Orleans.

The Minnesota Northern Railway Company has changed its name to the Northern Pacific, Fergus & Black Hills R. R. Co., and proposes to enter at once upon the construction of its road. The offices and shop of the company will be at Fergus Falls, Minnesota.

The Grafton & Greenbrier Railroad Company has been incorporated in West Virginia to build a narrow-gauge from the Baltimore & Ohio at Grafton to some station on the Chesapeake & Ohio in Greenbrier. The capital stock is $1,000,000.

A London, Neb., dispatch says that steps are being taken to build a road from Lincoln to Fremont, a distance of 60 miles, by the way of Wahoo, in Saunders County, and thence to Burt County, connecting with the Chicago, St. Paul, Minneapolis & Omaha Railroad. The old survey made by the Atchison & Northern line in 1875 will be used.

At a late meeting held at Cornwall, a company was formed, under the name of the Eastern Ontario, New York & Boston Railway Company. It was resolved to apply for charters to build a line of railway from Carlton Place to Cornwall, with the view of bridging the St. Lawrence at that place, and connecting with the railway system of New York and the New England States. The projected road would connect with the Canada Pacific and other lines at Carlton Place, and would form a means of transport to the United States and the seaboard.

A special dispatch from Dallas says: "Chief Engineer Marion, of the Missouri Pacific Railroad, said in an interview that it was an established fact that the Missouri Pacific road will be built to Galveston. The line is now being located from Virginia Point to Random on the Galveston, Harrisburg & San Antonio road. The survey from Waco to to the Inteanational and Great Northern road is completed. From the International, lines will be run to the mouth of the Brazos River and Aransas Pass, the latter survey to be made in six weeks.

An important contract was concluded last week at St. Johns by the Newfoundland government, represented by a joint select committee from both branches of Parliement, and by Mr. Blackman, representing a syndicate of New York capitalists, for the construction and maintenance of a railroad from St. Johns down to the mining regions of Notre Dame Bay. The proposed line will be about 400 miles, and will be the first railroad constructed in Newfoundland. The estimated cost is $6,000,000, and the syndicate, through its agent, guarantees its completion in three years. The Newfoundland government guarantees to the company an annual subsidy of $185,000 for 35 years, with a land grant along the line, in alternate blocks, of some 2,000,000 acres.

CONTRACTING, MISCELLANEOUS, ETC.

CONTRACTORS are a most unreasonable set of men. They want to learn all about every piece of work that is to be let, from Maine to Texas, but *they* "never will tell" where any "jobs" are. This is a big country, and the contracts are many. It would take a score of assistants reading all the time to look the papers of the country through, and the publication of the contracts each week would fill this whole paper. We would like to do the latter, but we must wait for a larger bank account before attempting the former. In the meantime we solicit every contractor to tell us all about the little and big contracts he is nursing quietly in the remotest corner of an obscure country newspaper.

The Suy Island levee is again broken, and an immense tract of territory inundated.

A company has been organized at Madison Bridge, Me., for the erection of a woolen mill to cost $100,000.

A block of granite has been quarried at Westerly, R. I., which weighed over 2,000 tons, and was 75 feet long, 40 wide and 8 deep.

Only two out of ten dams on the Milwaukee river were spared during the late freshet. The estimated loss along the stream is $100,000.

Hon. Wm. Windom, Secretary of the U. S. Treasury, advertises for proposals till May 10 for furniture for the Fall River (Mass.) Custom House.

Major W. J. Twining, U. S. Engineers, advertises for proposals for 25,000 yards concrete pavements for Washington, D. C., till May 25 next.

The contract for construction of 100 miles of the Toledo, Delphos & Bloomington Narrow-Gauge Railroad from Ramsey, Ill., to St. Louis has been awarded.

The Phœnix Iron Company, of 410 Walnut Street, Philadelphia, has been awarded the contract for the new iron pier at Coney Island. Work to be completed June 15.

The St. Joseph Valley Narrow-Gauge Railroad Company has resumed work upon its road, and expects to have it completed from Buchanan, Mich., to Berrien Springs in about 60 days.

The trustees of the insane asylum at St. Peter, Minn., have awarded the contract for rebuilding the north wing of the asylum, which was burned last November, to George Adkins, of Minneapolis, at $86,725.

WAGES IN PORTLAND, OREGON.—The general opinion is that there will be a demand for mechanics this year, and that wages will be greater than usual. The average wages for carpenters has been $3.00 per day.

PRICES OF OLD RAILS.—The Indianapolis Rolling Mill Company last week purchased 1,500 tons of old rails from the Cincinnati, Hamilton & Indianapolis Company, and 1,000 from the Ohio & Mississippi, paying $32 per ton.

CONTRACT AWARDED.—The contract for shafting, etc., for the Montreal Abattoir Company's works, has been awarded to Messrs. Robert Gardner & Son, of that city. It is expected that the machinery will be in position early next month.

The Northern Pacific Railway Company advertise for 2,000 white laborers at wages from $1.75 to $2.00 per day, and 200 carpenters and bridge-builders at wages from $3.00 to $3.50 per day, according to ability, to work on the Cascade & Pend Oreille divisions.

Columbus, Ohio, has appropriated $20,000 for the better heating, ventilating, and lighting of the State House, and a committee consisting of the Adjutant-General, Secretary of State, and Treasurer of State have been appointed to attend to the matter.

City Engineer B. F. Morse, of Cleveland, O., advertises for proposals till May 19 for dredging and removing bars and other obstructions from the channel of the Cuyahoga River, between the L. S. & M. S. Railway bridge and the new canal lock, and also the old river bed.

There is a great demand for civil engineers of ability. So many new railroad schemes are being sprung, and surveys for their location being made, that this class of men find ready employment. At the present time there are twenty-three surveying parties running lines in Indiana, fourteen of the number being employed in the southern part of the State.—*Indianapolis Journal.*

Major G. J. Lydecker, U. S. Engineers, advertises for proposals, to May 19, for furnishing and placing stone, for sinking and filling cribs and superstructure of the exterior breakwater at Chicago, Ill., during the fiscal year ending June 30, 1882. It is proposed to build 2,500 lineal feet of breakwater and the amount of stone required will approximate 12,500 cords.

Mr. John G. Hyatt, of New York, has filed plans for a large flat-house, which he proposes to erect at a cost of $550,000. The building will be constructed mainly of brick, stone and iron. It will be 7 stories high, 175 feet broad, front and rear, and 88.9 feet deep. Six families will be accommodated on each floor, or forty-two families in all.

Robert McCallum, Engineer of Public Works, Ontario, advertises till 7th of May next for dredging a channel between certain points on the Scugog River. Specifications can be seen at the Toronto Department, and at the office of Thomas Walters, Lindsay, where printed forms of tender can also be obtained.

Charles Berrick, of Buffalo, has been awarded the contract for the new Erie engine-house and shops, at Hornellsville, N. Y., for about $175,000. The machine and erecting shop will be 110'x470', and the engine-house 315' in diameter, with 44 stalls, to say nothing of a number of smaller buildings. The sub-contract for the iron work has been let to Mr. Fields.

Ravenna, O., is to have a 66 foot by 50 foot addition to its Court House, the addition to be surmounted by a dome 110 feet high. Samuel W. Lane, of Cleveland, is the architect; his plans and specifications were adopted on the 23d inst., and he was employed to superintend the construction. The materials are pressed brick and Windham stone. There will be fire-proof and burglar-proof vaults, etc. Work will be commenced on the building as soon after the first of June, at which time the contract will be let, as possible.

About two thousand men, including those clearing the route of timber, are now employed in the construction line of the Oregon Railroad & Navigation Company's Railroad, between the Cascades and the Dalles. The distance from the Lower Cascades to the Dalles, by the line as surveyed, is 47 miles. Much of the route presents great difficulties, though there are stretches of considerable length where construction will be quite easy. The number of tunnels beyond the Cascades has been reduced to two. One of these will be 200 feet and the other about 400 feet long.

Work on the new tunnel near Gould's Station, on the Pittsburgh, Cincinnati & St. Louis Railway is progressing. The contractors are Messrs. Farren, Patterson & Kerns, of Philadelphia, who have at present about 60 men at work on the approaches, the western one of which will be completed in a few days. Solid rock will probably be encountered the entire distance. The tunnel passes through a hill about 300 feet high. Recently the Pennsylvania Company notified the contractors that they were considering the question of making the tunnel wide enough for a double track. The original contract called for 19 ft. high and 20 ft. wide.

The largest contracts for tree products ever made in Mobile, Ala., were consummated recently between Mr. S. W. Hastings, purchasing agent for the Mexican National Railroad Company, and Messrs. Stoutz & Co. Messrs. C. C. Kauffman & Co. have contracted to deliver 400,000 feet of car and bridge timber during each month to Jan. 1, 1882, besides an unlimited number of cross-ties and piling. They have contracted for 100,000 cross-ties and 7,000 telegraph poles. All this timber is pine except the telegraph poles, which are of cypress. Various ports on the Gulf coast competed for this contract, but Mobile secured the prize.